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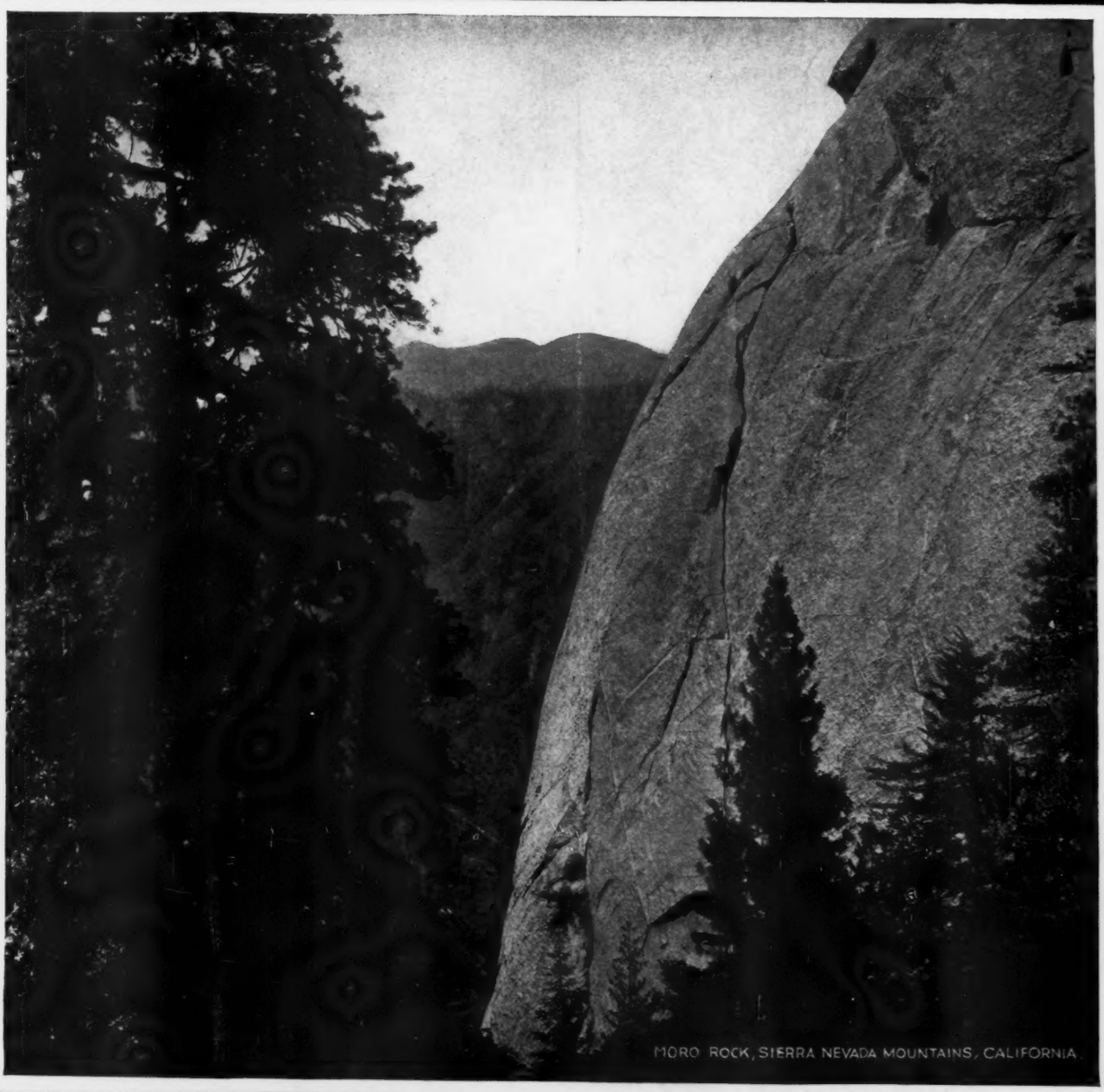

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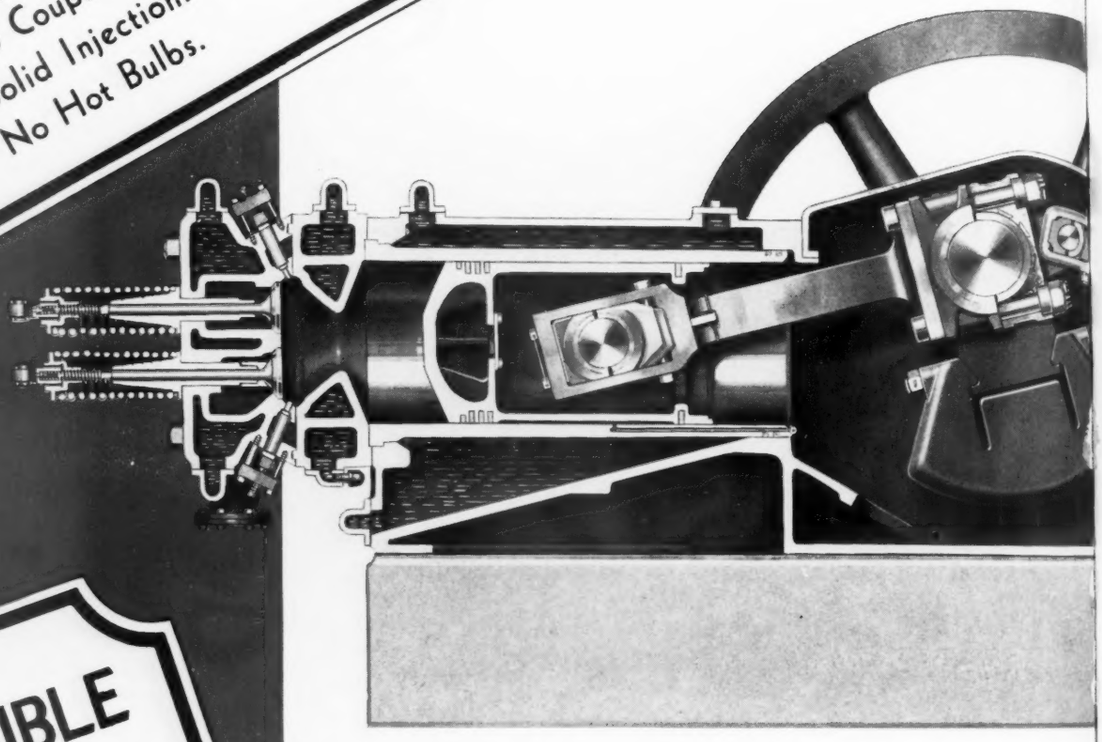

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As It Seems To Us

FLYING AND MINING

THE airplane is assuming a place of constantly growing importance in the mining industry. An article in this issue that tells how 60 tons of machinery was transported over the high Andes in Peru within twelve days is an instance of its utility. Similar stories might be presented from many portions of the globe.

In parts of Canada flying and mining are inseparably linked. Operations in many remote areas of the Far North would cease if the planes were to remain on the ground. Not only all mining equipment but also the food and clothing of the inhabitants are flown in. Aircraft have been successfully used in Canada since March, 1921, when the Imperial Oil Company flew two German-made planes to Fort Norman in the Mackenzie River region. On that occasion the propellers were damaged beyond repair when the planes broke through the ice in landing. The pilots met the situation by fashioning new propellers from some oak sleigh boards, using glue of their own manufacture. Their resourcefulness in thus improvising equipment which enabled them to get back to civilization did much to win the confidence of mining men in aërial transportation. From that time on the use of planes increased rapidly.

The pay-load capacity of the planes has been steadily raised until at the present time some planes handle 6,000 pounds. While large total loads can therefore be handled once they are aboard the planes, the loading of bulky and weighty single pieces presents numerous difficulties, and aviation executives have appealed to manufacturers to design standard types of mining and milling machinery with a view to making their component parts smaller.

The most remarkable aërial freight-handling exploit thus far recorded is, of course, the well-known operation in New Guinea by the Bulolo Gold Dredging, Ltd. In this instance, 2,500 tons of machinery and camp provisions were laid down at Bulolo, which is separated from the nearest port, Lae, by 50 miles of dense forests and high mountains. Over a period of twelve months approximately 1,000 flights were made, during which two large dredges, a 1,500-kw. hydro-electric generating station, a complete machine shop, a number of automobiles, and other miscellaneous equipment were transported in dismantled form. The decision to send this vast amount of material through the skies was made not only to expedite delivery but also to save money. Careful surveys indicated that it would cost $1,200,000 to construct an adequate road across the difficult terrain. The total expense of the flights, including the additional labor involved in dismantling and assembling the machinery at the take-off and landing fields, was $762,000. A clear saving of $438,000 was thus realized.

The airplane is also coming into wider use as a vehicle for the prospector. Its service in this connection is thus far largely one of eliminating from consideration areas which are obviously barren of mineral possibilities. Using small, inexpensive machines, it has been possible to cover large expanses of territory quickly and to observe and mark on maps those sections which show no out-cropping rock. Correlation and publication of the knowledge thus gained is enabling prospectors to shun these manifestly unfavorable areas and to concentrate their efforts on regions where they have greater chances of success.

TIMING RACES ACCURATELY

ARGUMENTS as to which man or which horse won a certain race bid fair to pass into the discard as a result of the delving of science into the realm of sports. A new mechanism which not only times all participants to a hundredth part of a second but also gives a motion-picture record of the finish has been developed through the collaboration of staff members of Electrical Research Products, Inc., and Bell Telephone Laboratories, Inc. The device was tried out at the 1933 Olympic Games in Los Angeles and has since undergone further tests which have proved its accuracy and reliability. Approval has been given it by governing bodies of various international, national, and intercollegiate games, as well as by the international and national aëronautical bodies.

The need for precision timing in racing events is evidenced by the fact that in the short dashes a runner covers a yard in approximately one-tenth of a second. Even where experts do the timing, it is impossible to secure more than a measure of accuracy with manually controlled stop watches, which have been conventionally used. In a 100-yard dash it requires .27 second for the sound of the gun at the starting point to reach the ears of the timers at the finish line and, even though the flash of the gun rather than its report signalizes the beginning of the race, it is easy to see that an error of a small fraction of a second can readily be made.

The new instrument provides a means of making, simultaneously, high-speed motion pictures both of the finish of the race and of a clock which records the elapsed time. Thus, any individual frame of the film will show the exact positions of the racers at that instant, together with the precise time that had ensued since they left the starting line. These pictures provide a permanent record of the race and enable judges to determine the winner beyond question in close finishes. As a matter of fact, recourse to the film in cases where the contestants were closely grouped at the finish line has already resulted in changes of decisions by the judges at several track meets.

The clock is electrically operated by a synchronous motor and is set in operation by a contact in the starter's pistol. The face of the clock bears three concentric dials. The central dial records minutes, the next one outside seconds, and the outer one one-hundredths of seconds. By photographing only a small segment of the three circular dials, it is possible to obtain the time down to a hundredth of a second. Allowing for all possible errors, tests indicate that this mechanism is accurate to within five-thousandths of a second for short races and to within one-hundredth of a second for a longer race such as the one-mile event. The apparatus was used officially at the Amateur Athletic Union Indoor Track Meet in New York last February, on which occasion pictures were resorted to by the judges for the determination of the winner of one event.

CALIFORNIA GOVERNS SAND HOGS

IN the interest of curbing compressed-air illness, or "bends", the California Industrial Accident Commission has adopted regulations which must be observed wherever men are employed under air of higher pressure than atmospheric. They do not apply to divers, however.

These Compressed Air Safety Orders, as they are known, prescribe the hours of permissible labor in air pressures up to 50 pounds, fix the time for decompressing from various pressures, and include other regulations designed to exercise rigid control over the working conditions of "sand hogs" and others who carry on in "high air." The allowable periods of labor range from two 4-hour shifts with an interval of half an hour in pressures up to 18 pounds, to two half-hour shifts with an interval of six hours in pressures from 48 to 50 pounds. They are identical with the provisions of the New York State Labor Law.

In addition to the mandatory provisions of the code are the following suggestions:

1. Be temperate, avoid all alcoholic liquors.
2. Eat moderately.
3. Sleep at least seven hours daily.
4. Take extra clothing into the tunnel when going on shift.
5. Decompress according to the decompression table.
6. Drink hot coffee and take a warm shower bath when your day's work is finished.
7. If taken sick, communicate at once with the physician.
8. Wear your identification badge.
9. Do not work more than two periods in any 24 hours.
10. Stay about the works one-half hour after locking out.

All Photographs
by the Author

SOME OF NATURE'S PATRICIANS

The sequoia, largest of all trees, is one of the few surviving links between the fir and cypress families. Fossil remains show that it was once widely distributed over the earth, but since the Ice Age it has been confined to a narrow belt along the Pacific Coast. Their shafts rising straight and true toward the vaulted heavens, these members of the famous Parker Group have been caught from an unusual angle of vision by the camera's eye.

Roadbuilding Amid Giant Sequoias

ORVILLE L. SNIDER

GOLIATHS OF THE PLANT KINGDOM

The tree above is the General Sherman, largest and perhaps the oldest living thing. It was discovered on August 7, 1879 by James Wolverton, a hunter and trapper, who named it for the army officer under whom he had served. Through countless fires it has continued to flourish and today it produces thousands of cones bearing fertile seeds from which many seedlings are grown.

At the left is a view directly upward along the furrowed trunk of a towering sequoia.

SEQUOIA National Park and General Grant National Park, both of which are located on the west slope of the Sierra Nevada mountains in eastern central California, were created to preserve the groves and forests of California big trees (*Sequoia gigantea*). Said to be the oldest living things, these stately giants, many of them from 3,000 to 4,000 years old, afford one of Nature's grandest spectacles. Here stands the General Sherman, granddaddy of them all, 272 feet high, with a circumference at the base of 101 feet. One of its limbs, although 120 feet off the ground, is big enough to be a tree in its own right. It measures almost 7 feet in diameter. And General Sherman is only one of hundreds of such trees, some of them in groves, such as the Parker Group of eight magnificent specimens that have survived the forest fires since the days of the Roman Empire.

The two parks are not far apart as the eagle flies, but the automobile tourist must travel 63 miles from one to the other at the present time. Uncle Sam, through the agency of the National Park Service, has taken cognizance of this situation, and a new highway to be known as the Generals Highway will reduce the distance to 30 miles, or less than an hour's drive. When it is completed it is expected that the majority of the people who visit the section will see both parks, whereas the present road discourages many from driving to one from the other. Besides reducing the distance, this new highway will create one of the most scenic drives in the West. Hung like a thread upon the slopes of the Sierra Nevadas, at an elevation between 6,000 and 7,000 feet, it will overlook the fertile San Joaquin Valley, and afford the traveler intermittent entrancing vistas framed with the cathedral stillness of age-old trees.

OUR COVER PICTURE

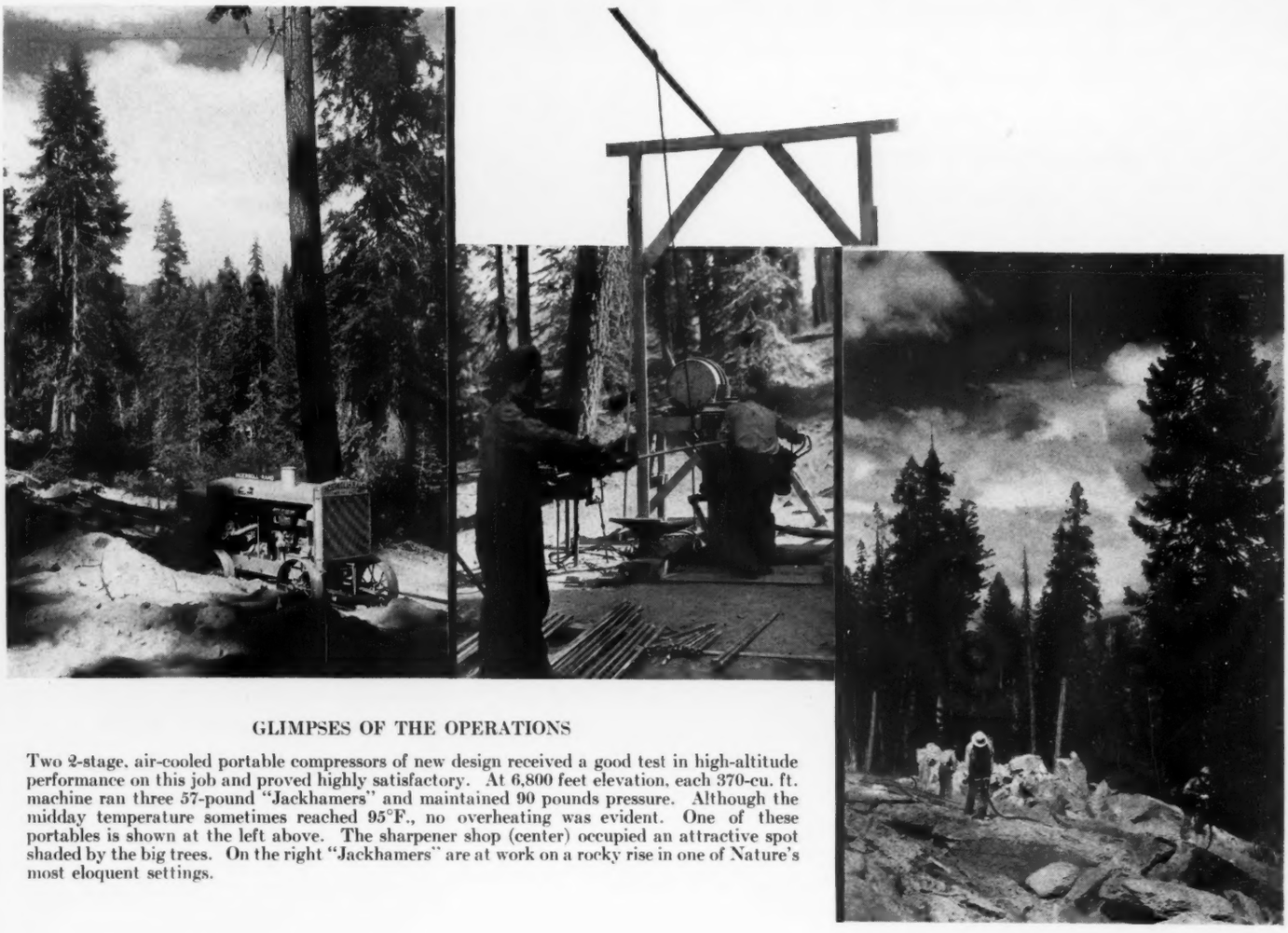
Moro Rock, located in the general region discussed in this article, is one of the lesser known spectacular scenic features of the Sierra Nevada. Of igneous origin, it is projected 6,000 feet above the San Joaquin Valley. From its summit, which is easily accessible by means of the "Stairway of a Thousand Steps," to the silver streak of the Kaweah River at its base, is an almost sheer drop of 4,119 feet.

One important link of this new highway within the boundary of Sequoia Park will be completed by snowfall of this year by Contractors Gist & Bell, of Arcadia, Calif. Their contract, which will be completed ahead of schedule, is 3.47 miles in length and involves 143,000 yards of excavation and grading and the construction of two concrete bridges of the arch culvert type.

Work was started on this contract on June 1, 1933, and since, because of fire hazards during the dry season, Federal regulations will not permit the burning of timber after July 10 of each year, the contractors had only

ROADBUILDERS INVADE THE FOREST PRIMEVAL

The entire 30-mile road was routed so that not a single sequoia would have to be removed and it is required of contractors that they carry on their work without injuring any of these trees. Drilling and blasting were done in such a manner as to break the rock without scattering it. Any material thrown outside the fill lines had to be moved back again. "Jackhamer" men are here shown blockholing large bowlders resulting from a primary blast.



GLIMPSES OF THE OPERATIONS

Two 2-stage, air-cooled portable compressors of new design received a good test in high-altitude performance on this job and proved highly satisfactory. At 6,800 feet elevation, each 370-cu. ft. machine ran three 57-pound "Jackhamers" and maintained 90 pounds pressure. Although the midday temperature sometimes reached 95°F., no overheating was evident. One of these portables is shown at the left above. The sharpener shop (center) occupied an attractive spot shaded by the big trees. On the right "Jackhamers" are at work on a rocky rise in one of Nature's most eloquent settings.

40 days to clear the right of way of some 1,300 fir and pine trees. Clearing was done by manual labor, and a force of 125 men working under the special provisions for emergency construction of park highways with a minimum wage of 50 cents an hour, completed the task on time.

The Federal Government treats these areas as if they were flower-bordered city parks instead of virgin country which only a few hardy persons have seen. It is the belief of those in charge of these improvements that the primeval beauty of the forests should be preserved, and the entire 30 miles of highway has been routed so that not a single Giant Sequoia is to be removed or harmed. To accomplish this, the regulations specifically forbid contractors to use any equipment outside the fill slopes; and any material thrown outside these lines by blasting must be moved back with a winch and cable, the winch to be located on the grade line. Any damages done the trees must be repaired by the contractor. During the progress of the contract under discussion Eric Earhart has been on the job as a representative of the Government to see that these regulations are obeyed.

To carry on the work economically while conforming with the restrictions imposed upon them, Gist & Bell carefully controlled all blasting so that the costly procedure of replacing material blown outside the roadway limits could be avoided as much as possible. The bases of trees adjacent to the work were protected with sheets of corrugated iron to prevent their being damaged by flying rocks. Much of the excavation was in granite of varying hardness, ranging from a hard blue variety known as Blue Sierra to decomposed rock. Blasting was accomplished by the drilling of numerous, well-placed holes that would lift and break the solid rock without throwing it far.

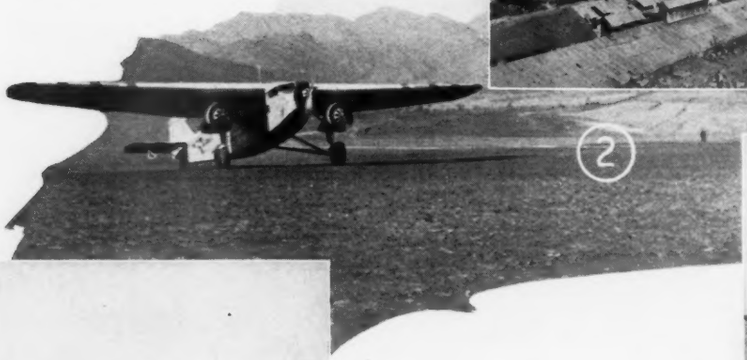
Nine Type S-49 "Jackhamers" equipped with blower tubes were used for the drilling. Compressed air was supplied to them from three compressors, two of which were the new Type 40 two-stage, air-cooled machines recently placed on the market by Ingersoll-Rand Company. These units are designed especially to meet the conditions present in the rarefied atmosphere of high altitudes and their performance in this instance fully bore out the claims of superiority over conventional water-cooled types that have been made for them. John C. Gist of the contracting firm states that, at an elevation of 6,800 feet, one 370-cubic-foot machine consistently operated three "Jackhamers" and held 90 pounds pressure. The air was delivered through 200 feet of pipe line and no storage capacity was available other than the standard receiver on the compressor. When only two drills were drawing air, the pressure quickly built up to 100 pounds and remained there with the compressor intermittently operating and idling. Even at this altitude, the temperature often ranged from 85 to 95 degrees, but no trouble was experienced with over-heating of the air-cooled machines. The third compressor furnishing air to the drills was of 310-cubic-foot capacity. A small portable unit supplied power to operate an Ingersoll-Rand No. 40 drill steel sharpener which was located in an attractive setting shaded by Giant Sequoias.

Two Bucyrus-Erie shovels—a gas+air, and a diesel-powered 43-B—loaded blasted materials into 7-cubic-yard trucks for hauling to fills. Three "Caterpillar" tractors equipped with "bulldozers" smoothed these fills and kept the right of way open for the trucks.

Most of the work was carried on by daylight in two 5-hour shifts. During one month, however, the shovels were required to operate four 5-hour shifts to keep up with the drilling. Two portable Kohler electric plants lighted the night work, with a third Kohler plant to light the construction camp.

Gist & Bell's contract calls for the completion of their work by the middle of 1934, but by the judicious use of good equipment their task is now nearing completion, and they will be gone well before the snow again blankets the Sierra Nevadas and makes of the Giant Sequoias the world's grandest Christmas trees.

HAULING 60 TONS OF MACHINERY BY AIR



1—Some of the mining company buildings at Progreso, near the delivery point.

2—The Ford tri-motored plane landing at Cuzco.

3—The valley of the Mancahuara River, where the hydro-electric plant is being built. Terraced farms of the Indians dating back to the Incas, are visible on the opposite hillside.

4—Loading the plane at Cuzco. Note the bathtub at the lower right.

5—Part of the flywheel of a compressor goes aboard.

6—The box being lowered into the plane contains parts of an Ingersoll-Rand compressor.

7—Unloading a turbine casing.

Flying Heavy Freight Into the Peruvian Andes

BREESE ROSETTE

A TON AT A TIME

Some of the heavier pieces, such as the transformer shown here, weighed as much as 2,000 pounds. The average load carried on each trip was 3,000 pounds. The entire consignment of 60 tons was transported in 12 days. The plane averaged four round-trips daily, the loading and unloading operations consuming more time than the flights.

HISTORY has it that in November, 1533, Pizarro led his victorious little army of Spaniards into the ancient Inca capital of Cuzco. When they saw the magnificent collection of golden objects in the Temple of the Sun, they immediately sought to discover the source of the yellow metal. Eventually they were told of several places, and among them was mentioned "Ccochasayhuas," which was said to be in a southwesterly direction from Cuzco. The Spaniards soon found their way to it, and within a short time were engaged in operating that old mine of the Incas.

Today, after 400 years have passed, the Ccochasayhuas Mine is still producing gold. Situated high in the Andes, beyond the Apurimac River from Cuzco, it has made some contribution to the gold output of Peru during this long period; and at the present time, with modern methods and equipment, its production is continuing steadily.

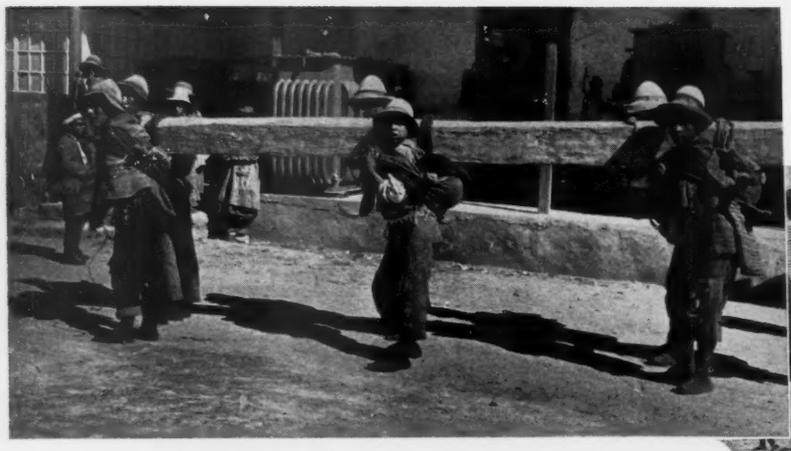
One of the most difficult problems in its operation has been that of transportation. In a straight line the mine is about 60 miles from Cuzco. But in those 60 miles one has to climb a high mountain range; descend into the deep canyon of the Apurimac; climb up the other side; and then still travel some distance through steep and rugged country. The Inca subjects made the journey on foot. The Spaniards brought in horses and mules, and until just recently this method of transportation had not been improved upon. With frequent changes of animals the trip can be made in two days from Cuzco, but the average time taken is three days. In carrying freight over this extremely difficult trail, sometimes four weeks are consumed before it reaches its destination.

In this century the mine has been operated by several different concerns. In 1930 the Compañia Exploradora Cotabambas took over the property, and since then has brought the old mine to an important position among the gold producers of the country. Under the able management of Enrique Torres Belón, prominent Peruvian mining engineer, new ore bodies have been opened up and modern equipment installed. But the question of transportation of supplies into the mine continued to be a great problem, and the old system of mule-back haulage was responsible for long delays and a large proportion of the cost of operation. A railroad was out of the question; and the cost of building a road over which motor trucks could run was prohibitive. It remained for the airplane to offer the solution.

Some time ago negotiations were entered into with the Peruvian Airways Corporation,

a division of Pan American-Grace Airways, Inc., operators of the great air-transportation system that links the Canal Zone with most of the countries of South America. A landing field was found near the mine, and several trips were made there from Lima by plane, taking in supplies that were urgently needed. This year a hydro-electric plant was to be installed. Time was of the utmost importance, as the work of installation had to be done in the dry season; and to handle the equipment in the old way by mule back was out of the question. Many of the pieces were of such weight that they could not be carried by mules even on a good trail; and the condition of the one between Cuzco and the mine was so bad that it was utterly impossible to bring in the machinery in that way. Accordingly, after some experimental work, a contract was made between the Peruvian Airways and the Compañia Exploradora Cotabambas for the transportation of most of the plant equipment by plane from Cuzco. Aside from this, some additional machinery for the mine was included.

For this work was used a Ford tri-motor cargo plane similar to those in the regular passenger service of "Panagra." (Panagra is the customary abbreviation for Pan American-Grace Airways). It was equipped with three supercharged 450-hp. Wasp engines and the standard Panagra 2-way radio for maintaining communication with other planes and Panagra ground stations. An opening in the top, approximately 10 feet long and 4 feet wide, permitted loading the larger pieces. Tests were conducted at the Lima airport to make sure



NATIVE FREIGHT TRAIN, AND PLANE CREW

There is no road into the mine and for four centuries supplies have been carried in on mule back or by native burden bearers (above). Sometimes four weeks were required for the journey.

At the right is the crew that manned and serviced the plane which completed its contract without mishap. From left to right the men are: Ewing mechanic; Parks, radio operator; Jardine, pilot; Varas, assistant mechanic.

that the plane could fly on any two of its motors at 15,000 feet altitude, in keeping with standard Panagra requirements. In June of this year the final tests were satisfactorily passed, and in the latter part of that month a flight was made from Lima to the mine with a load of freight. From there the plane proceeded to Cuzco, where almost 60 tons of freight was waiting, having been transported there from the Port of Mollendo over the Southern Railway of Peru. Within about twelve days all this material was carried into the mine with the plane.

Some of the pieces weighed about 2,000 pounds apiece—there were several Westinghouse transformers that weighed each about this amount. The average time of each flight from Cuzco to the landing field at Huanacopampa was from 30 to 35 minutes. An average of four trips per day was made—the unloading and loading, of course, consuming more time than the actual flying. Boom derricks operated by low-ratio hand winches were used for loading and unloading the heavier pieces. Some of the smaller ones were handed through the side door of the plane. On most of the trips the total load carried was about 3,000 pounds.

Besides the hydro-electric equipment, the flying machine delivered at the mine two Ingersoll-Rand Type XRB-2 compressors and an Ingersoll-Rand No. 50 sharpener. These machines were knocked down so that the heaviest pieces were well below the weight limit set. The heaviest part of the sharpener was the base, weighing about 950 pounds, and that was very easily handled.

This project marks the beginning of a new era in Peruvian mining history. The problem of transportation has always been a vexing one in this great mining region, located as it is in one of the most rugged and precipitous parts of the Andes. Many a promising mining property has been retarded in its development because of the slow and costly handling of freight by mule back and because some classes of equipment were almost impossible to move in this manner. Now the way has been shown, the trail broken, so to speak, and undoubtedly the aërial handling of machinery and supplies in this section of the world will be developed to a still higher point of efficiency.

Some details in regard to the Ccochasayhuas Mine will be of interest. It lies at an altitude of about 15,000 feet above sea level. It is connected with Progreso—where the milling plant, shops, and general offices of the company are located— by an aërial tramway. The milling plant has twenty 750-pound stamps and complete amalgamating and cyaniding equipment. The construction of a new one, with a considerably greater capacity, is planned. A tunnel to cut the vein at a deeper level is also projected. It is to have a length of about three kilometers, 1.85 miles.

The hydro-electric plant is being built on the Mancahuara River several kilometers from Progreso and at an elevation about 2,000 feet below that place. Its ultimate capacity will be 2,250 hp., of which two 750-hp. generating units are being installed immediately.

The Compañia Exploradora Cotabambas is a Peruvian company, its principal stockholders being prominent citizens of the country. The firm of A. & F. Wiese S. A., of Lima, acts as consulting engineers. The whole enterprise is a striking example of a mining property originally worked by the Incas and Spaniards that has been brought to the peak of efficiency by modern methods and equipment.

RIVETING A PENSTOCK

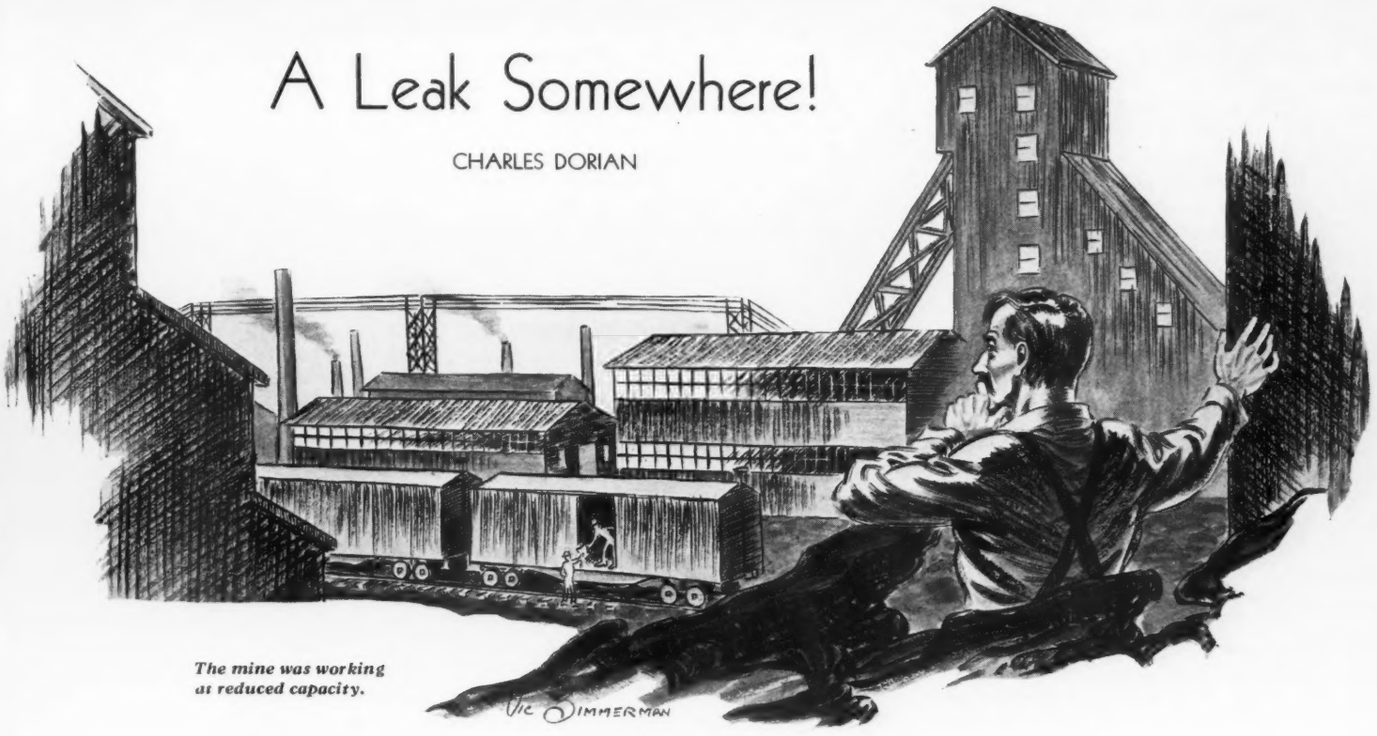
Much of the equipment was shipped in knocked down form and assembled on the job. Native workmen are here shown fabricating a section of steel penstock.

COMPRESSOR AT WORK

To supply air for the penstock riveting and for other purposes in connection with the erection of the power plant, this Type XB-2 compressor was set up out of doors.

A Leak Somewhere!

CHARLES DORIAN



The mine was working at reduced capacity.

YES, there was a leak somewhere! The mine was working at reduced capacity, and there were as many native sons on relief as there were in the mines.

That was inevitable. Under any system where machines are necessary to provide work the most efficient handling has to be considered. Therefore, as the gangs were depleted, the lazy ones were laid off first. The weeding process became more and more difficult as the comparative worth of the men was weighed. The minimum had been reached, but there was the fear in the hearts of all that still further cuts would come. A mad competition of effort resulted among all ranks: muckers, drillers, powdermen, and mechanics.

There were two bosses on every shift: one in charge of general operations on the levels, and one directing the work of the drillers and muckers, or trammers. The third shift, midnight to 8 a. m., known as the "graveyard shift," was given over to the powdermen supervised by a shift boss.

Superior to all shift bosses was the mine captain, and above him again, the mine superintendent. All the level bosses were natives while the other shift or drill bosses were of foreign extraction —except one.

Each man had his work to do, so that petty rivalries among bosses was a rare thing. Unless a serious blunder was made, the mine captain shouldered the responsibility and kept up the harmony for which this mine was noted.

The natives out of work naturally felt that they should be given preference in jobs over outsiders, and that caused some ill-feeling. The foreigners out of work made no trouble but depended upon their friends on the inside to get them jobs whenever a chance came up, and the ones on the inside were determined that every man replaced should be one of their own kind, and they worked like demons for that privilege.

John Livingstone, drill boss, was a small Scotsman of quiet habits and droll manner. He had a keen knowledge of stoping operations. His was the four-to-twelve p. m. shift, while Matti Maki was considered king-pin drill master on the eight-to-four or day shift.

There was a time when the variation in work performed by each drill shift was small, but latterly the gang under Matti Maki had outstripped all the others, securing their jobs against the next possible lay-off. John Livingstone was worried.

He was shown the charts by Captain Wolfe, who explained to him that when its production got below a certain ratio it would be more economical to cut out the shift altogether than to continue operating it. And when drillers were laid off a corresponding number of trammers and the others had to go, too.

"The company has to make a profit to keep running at all," he explained, "though it might take a small loss to keep its best men on the ground ready for resumption of better times. What's got into your crew, Jock"

"The crew's a'richt," John affirmed. "Naething wrang wi' they uns. They're the best in the mine".

"The facts give Matti Maki's men that honor as you can see by the charts," Captain Wolfe showed him.

"There's something gone daft wi' the machines," argued John. "Yon laddies are a'richt."

"Now, John, you know better than that. The drill doctor gives as much attention to your machines as to the rest."

"Aye, I wonder now. He's na a pairteecular fraind o'mine, I'm thinkin'."

"I'm willing to give you every chance to prove your point," said the captain. "You used to have the king-pin drillers. You held the record a long time. If you think it's the machines I'll give you a bunch of new ones."

"I'm na sayin' the machines are na good," said John after a week's experiment with some new ones. "But they're a' alike—no pep, no power."

"You're not complaining about the pressure, I hope," said the captain. "It's the same for you as for Matti."

"Aye, mebbe so. But he's in a different stope."

"You're not hinting that he's in softer ore?" laughed the captain. "It's all sulphide, and you wouldn't call any of it soft."

"Truth I would not. It's hard as diamonds."

"You get the same service out of your steel. It's all sharpened the same way and it's not hand picked for anybody."

"I'm na complainin'. But mebbe if Matti took over my stope for a week and gi' me his, we'd then see if it's men, machines, or air that's wrang."

"I'll see if Matti is agreeable," demurred the captain.

It turned out that Matti was more than agreeable. He was eager for the test. So it was amicably arranged.

The results were amazing. Matti's men broke their own record in John's stope!

"So that would prove that you are not in harder ore," again reminded the captain. "Your boys are on the decline, I'm afraid. Now, I don't want to be hard on the boys but I'm going to suggest that you lay them off for a month and put on a fresh gang from some of the men we laid off. I'd do the same with Matti if he showed signs of weakening. We want to get all we can out of the machines to prove their worth, and the longer we keep out of the red the sooner better times will come."

John Livingstone.

A mad competition of effort resulted in all ranks

Matti Maki.

Still John was not satisfied. He would go down fighting for his men.

"Gi' them anither test. There's bonny drillers in both stopes on the day shift. Put one o' them gangs on my shift wi'me, and put my gang on the same shift as Matti's."

"Well, now, that's fair enough, John. Then if your crew can keep up with Matti's we'll leave them on the day shift. It will depend upon what Matti says, however. He might get touchy with all this shifting around. He is senior boss, you know, and earned the day shift as a promotion."

"He'll na kick, I'm thinkin'," prophesied John, sagely.

And he didn't. Matti was smooth. His round baby face lit up all over with a smile. He said he'd compete his gang with any other, any time, any place, and for a bet if Jock were willing.

"I'm na bettin'," emphasized John. "It's na a sportin' proposition. It's a test."

This time the results were baffling. John Livingstone's crew under the direction of Matti Maki broke all records in the history of the mine. The two Maki crews under John's tuition slumped correspondingly.

"What do you make of it?" asked the captain.

"Must be the shift," grinned John, glad that his men had shown their mettle under a strange boss, and not at all apologetic for making so little out of the two Maki gangs.

"It's still kind of puzzling," admitted the captain. "How that gang of yours can work just because they're put on the day shift and Matti's No. 2 gang so rotten on the night shift. It beats me."

"There's still anither test," John had the hardihood to suggest. "Put Matti Maki and his two gangs on the night shift and me an' my gangs on days—just reverse us aroond, ye ken?"

"Are you trying to prove that daylight makes for efficiency down in the belly of the earth where it never penetrates?" asked the captain, amusedly.

"There's a somethin' i' the change o' shifts," hinted John, winking knowingly.

"Now, Jock, this is positively the last test. I know Matti will agree because it is all in the interest of better costs."

"That's the speerit," agreed John, with a peculiar grin. "But there'll be ane mair test," he threatened.

"Come now, Jock, there's a limit."

"A' richt. One week o' this try-out and I'm thinkin' we'll be givin' a few mair o' the onemployed a job."

"What do you mean?" The question was sharp.

"Bide a wee," pacified John, winking again.

"You're a queer bird, Jock. Something up your sleeve, eh?"

"Mebbe ye'll guess it afore the week's up," he nodded.

"Of course, you'd never tell me?" angled the captain.

"I'd ne'er do that. Matti'd think ye're a hell of a captain."

"And I suppose that's what you're thinking now?" laughed Wolfe.

"Wi' all due respects, Harry, I'm thinkin' I am."

That set the captain to thinking more ponderously than usual. The superintendent called him in one day during that week of what was to be the final experiment, and said:

"Have you run down that trouble with the drill crews, Harry?"

"No. I've left it up to John Livingstone to find out what it might be. He has put up what I thought at first were ridiculous suggestions, but he's a canny lad, and I believe he has known for some time what the trouble is."

"Can't you to get him tell you?"

"Jock's got a sense of fair play. It's something he thinks I should have found out myself and he's stalling on these tests of his to give me the opportunity to find out."

"Then it's up to you, Harry. The tests have been of some material benefit, of course. They have proved that it is not in the ore structure, nothing the matter with the type of drills we're using, and the steel sharpening is up to standard. There's somebody monkeying with the air line!"

"That is what I have thought from the start, and I have systematically examined all joints personally and can find no leaks anywhere."

"Here comes John now. He gets around pretty early for his shift, doesn't he?"

"Yes. I've noticed that. I've had a mind to shadow him, but I'd hate to let him catch me," smiled Wolfe.

"I think you'd better. There's no sense his coming on duty half an hour ahead of time any more than there is coming half an hour late."

"All right. I'll give him time to walk to the shaft and then I'll 'phone the toplander to have the station tender on the twenty-fourth level hold him there till I get down. I can at least ask him why he comes in so early."

They talked of conditions in the mine generally according to daily habit, and at half past three Wolfe took up the mine 'phone and called the toplander:

"Has John Livingstone gone down yet?"

"Just going down, sir. Cage starting now," came the reply.

"Call twenty-four and tell him to hold John at the shaft till I get down."

"Right, sir."

He was leaving the office when the 'phone jangled. The superintendent called him back and handed the receiver to him.

"What? Can you hold him there? No? All right." Hanging up, he turned to the superintendent:

"He went right down to thirty. No station tender there. Wonder what the devil he means roving all over the mine like that?"

"Guess it's up to you to find out," hinted the superintendent, somewhat coolly.

Captain Harry Wolfe, tall and slim, clad in overalls, rubber boots, and hard-boiled hat, was down on the next trip of the cage. He made a trip down once a day for general inspection, but he knew nothing ever changed down there. The pumpman made a daily trip, too, and performed all the necessary work.

This was the bottom of the mine, and only development work had been going on down there. Since the curtailment of operations even that was stopped, and the diamond-drill company had taken its drills away. It was the dead level of desolation down there. It gave one a creepy feeling just to be alone there.

Harry Wolfe walked along the main cross cut, stopping every few feet to listen for other boot falls on the resounding rocky floor. The only sound which came to his ears was a light tap-tap-tapping, like a flock of woodpeckers in action somewhere far above. These were the drills in operation some six hundred feet above in solid rock.

He walked a few feet into every drift and listened, retracing his steps to the main crosscut. Once he saw a carbide light bobbing up and down, and he hurried to reach it. It disappeared suddenly, and he stopped where he thought he had last seen it at a manway to the level above. He started climbing. He was a fast climber, but the man on the ladder above him was faster. He followed him up as far as the twenty-fourth level where the day shift was streaming out of the stopes with dinner pails and the second shift coming in. He was sweating and puffing from the hard climb. Presently he saw Matti Maki, who was sweating and puffing, too. Matti grinned expansively and greeted the captain with a cheery:

"Hullo, Cap. How's she go?"

"Fine, Matti," replied Wolfe. "You're hitting your stride again, I see. Keep up the good work."

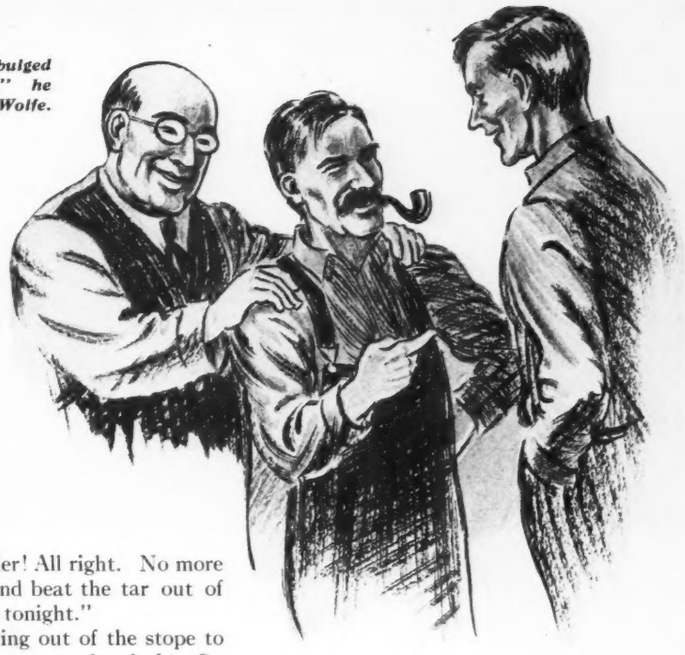
Matti was gone. John Livingstone came along in a lather of sweat.

"My word, Jock!" greeted the captain. "You look as if you'd done a day's work already."

"I het up quick," puffed John. "It's not often I help the lads wi' the tripods."

"Where are tripods on the thirtieth level?" asked the captain, pointedly.

John did not change expression, if expression can change much under the flicker of a carbide light. "I keep me lunch pail down there—it's warmer," grinned John.



"The air hose fair bulged wi' the pressure," he grinned, winking at Wolfe.

"You lyin' Highlander! All right. No more questions. Go on in and beat the tar out of Matti Maki's record tonight."

He left him. Crawling out of the stope to the drift he made his way to the shaft. On the surface he armed himself with an electric flash lamp and a revolver and went back to the shaft, taking a ride to the thirtieth level.

He walked to the end of the main crosscut and into a drift where one of the diamond drills had been located. He gave it a thorough inspection and turned into another drift where the second drill had operated. He had only entered the drift when he knew why he had decided to make this trip. A hissing of air greeted him, and he followed the sound to its source. He reached over and turned the valve that had been opened in the air line. The hissing ceased.

He went home for supper and told his wife he would be at the mine all night—something important. No more thorough inspection had that mine ever received than upon that night. Shift bosses and men alike opened their eyes (some of them had been closed for an hour) to see this apparition among them.

He kept out of Livingstone's stope. He knew instinctively that Jock would be busy and that there would be a better "feel" to the machines. He put in the whole night underground and marveled at his own stamina.

At 7.30 a. m. he went back to the thirtieth level, back to the diamond-drill operating valve, opened it wide, and waited in the darkness. A carbide light came bobbing along near the ceiling of the drift. A huge hulk loomed up close to where he stood and he saw that it was Matti Maki, saw his hand close over the valve handle and sensed the cessation of the deafening exhaust of air.

He thought he should challenge this underhand worker, but discretion changed his mind. Men like Maki, unexpectedly apprehended in a trick like that, get vicious. A body could be thrown anywhere and covered with a pile of loose rock and it would take days to find it. No, though armed, he thought he would let him amble away. He wanted to tell John Livingstone something. He went home and slept till one and turned up at the office at two. He told the superintendent of his discovery.

"No wonder you could not find the leak before!" sympathized that officer. "After this I suggest staggering your hours of duty so that at some time you will have covered the whole three shifts."

"Yes, and I'll cover the whole mine from now on," supplemented Wolfe, "especially temporary workings. How do the charts look for last night?"

The four-to-twelve shift was on top, naturally," smiled the suprintendent. They went over the charts together, and it was concluded that all departments showed more pep that night. They waited for John Livingstone, who came in early again They sent for him to come into the office before going to the changehouse.

"Good work last night, John," praised the superintendent. "How do you account for it?"

"The air hose fair bulged wi' the pressure," he grinned, winking at Wolfe.

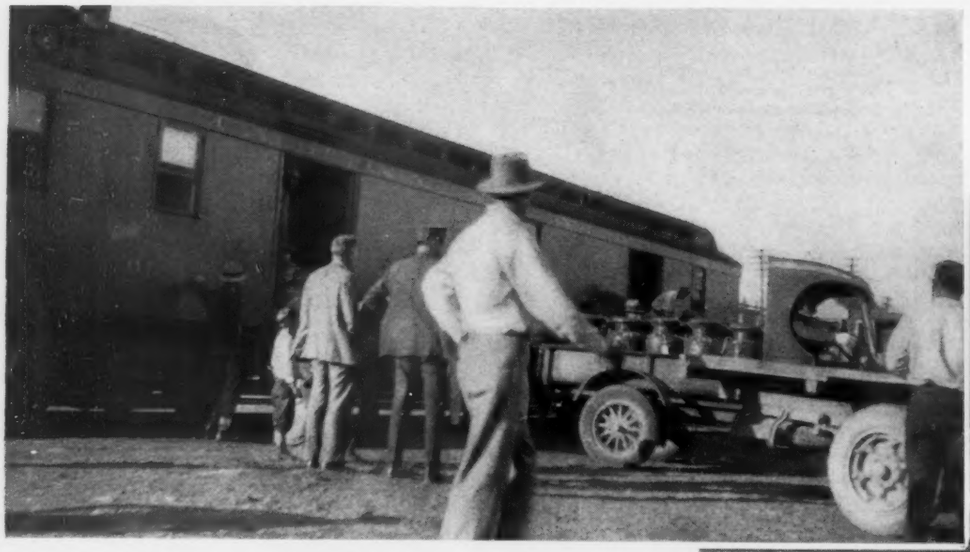
"Why didn't you shut that valve on the thirtieth level when you knew it was open?" challenged Wolfe.

"It was none o' my business. I knew ye'd find it yoursel' afore lang."

"You were right. Now, John, you go right back and round up sixteen drillers and helpers for the eight-to-four shift tomorrow. They'll finish the week out under your charge. When you get them lined up into regular shifts your head driller will be the new boss on the four-to-twelve shift. That makes another man you'll have to replace."

"Thank ye, sirs, both o' ye," smiled John, turning away to spread the good news.

Matti and his two gangs of reputed experts were given twenty-four hours to transfer their activities to their own wood piles, and the troop of out-of-works that John Livingstone brought in prattled like children when they received their badges of reinstatement.



ON THEIR WAY

Above, cans of trout fry are being transferred from a railway car of the California Fish & Game Commission to trucks in which they will complete their journey from hatchery to stream. Another such car is shown in the central picture. These cars carry air compressors for aërating the water in the cans periodically to replenish the supply of oxygen. At the right is one of the special trucks maintained by the California commission for transporting hatchery fish. At the bottom of the truck body, just back of the cab, is a small compressor with its air receiver. These facilities make it possible to introduce oxygen into the cans at any time.

Planting the Trou

THE propagation of game fishes and their distribution to streams and lakes frequented by sportsmen has become a highly specialized governmental function in those states which are fortunate enough to possess waterways and climates in which the more lively members of the finny tribe will flourish.

Each year a vast army of sportsmen sallies forth to the haunts of the trout, the bass, the muskellunge or other justly famous fighting fishes. Huge sums of money are spent upon tackle, train fares, gasoline, food, accommodations and the other sundry commodities, chattels and services that enter into the great American pastime of goin' fishin'. The more ardent devotees of the sport will travel across the country to wet a line. States which are favorably endowed by Nature have long since learned that aside from the health-building recreation which it affords their own populations the effort that they expend in maintaining good fishing proves excellent bait for the more serious purpose of luring hordes of visitors who will leave welcome money in their wake.

For the most part, this business of stocking streams and lakes is a self-sustaining one. Those states which harbor the more famous fishing grounds, and particularly those which are situated within easy access of large population centers, derive sufficient revenue from license fees to carry on their activities. This is a happy and seldom-met state of affairs; and it insures support of the endeavors by the taxpayers, whether or not they are personally gripped by that insatiable hobby that Isaac Walton elevated to prominence.

Although several varieties of fishes are raised and transplanted, more attention is given to trout than to any other one type. This is so not only because the trout is a hardy fish that thrives in a large proportion of our inland waters, but also because it is a desirable quarry from the sportsman's standpoint. Arguments as to which is the gamest fish for its weight are perennial, but at least the trout is always accorded a place on the preferred list. This brilliantly hued streak of animated lightning always puts up a first-class fight when luckless enough to be fooled by the wiles of the angler. It is a fit opponent for any man; and even presidents find the quest for it pleasurable and relaxing. An additional reason for its popularity is the tastiness of its meat.

The trout belt of the United States includes virtually all the mountainous states from coast to coast. The fish does well in lakes, but is essentially a stream dweller. It demands clear, relatively pure water, and prefers it cold and swift.

Practically all states where trout fishing is followed to any extent maintain hatcheries and have in force some system of distributing the product of them to the streams and lakes. The extent of these activities and the details of carrying them out vary according to the conditions that prevail in the various areas covered. Methods that work well in one state are not feasible in others. For example, in New Jersey, trout ranging up to 14 inches and more in length are hauled in tank trucks from the great hatchery at Hackettstown, and dumped into the brooks and rivers. This is done once a week during the open fishing season and insures fair sport for anglers at all times even though literally thousands of them whip the streams.

The New Jersey system wouldn't work in the large Western states because of the much greater areas to be covered. Many of the fishing streams are remote from hatcheries and are reached by roads that call for slow traveling, especially by heavy trucks. To meet the conditions that obtain, the several Western states have worked out systems of their own for distributing the hatchery fish. In principle, these practices are generally similar and the differences are primarily in the completeness and elaborateness of the facilities that are provided for carrying them out. California stands among the states that have developed effective methods and equipment and the brief description which follows may be taken as fairly typical of what is done in other Western states.

IN THE HIGH COUNTRY

Three of the pack mules shown above are carrying cans of trout. This method of transportation is adopted to reach areas not served by roads. The cans are shaped so that they will fit the sides of the animals. They are jacketed with moistened heavy cloth to keep their contained water cool as long as possible. At the left a can of small trout is being dumped into California waters. These fish will grow at the rate of two inches and upwards a year, depending upon the altitude, the amount of food they receive, and other factors. They are planted in sheltered waters in order to give them every chance to escape their larger and cannibalistic tribesmen.

e Trout Crop

The distribution task in California assumes large proportions because of the size of the state and the correspondingly large number of fish that is required to keep the streams and lakes replenished. Within a single year more than 19,000,000 fish have been transplanted from the hatcheries. Diverse means of transportation are employed. Two especially equipped cars serve districts that are reached by rails. Motor trucks, also outfitted expressly for the purpose, extend the distribution farther; and beyond the range of their travel pack trains are utilized.

The trout are transferred from hatcheries to natural waters as soon as they grow to a size where they are capable of taking care of themselves. Depending upon the hatchery capacity available and other controlling conditions, they may be turned out to shift for themselves when two inches long, or they may be held until they attain a length of five or more inches. Small trout are known as "fry."

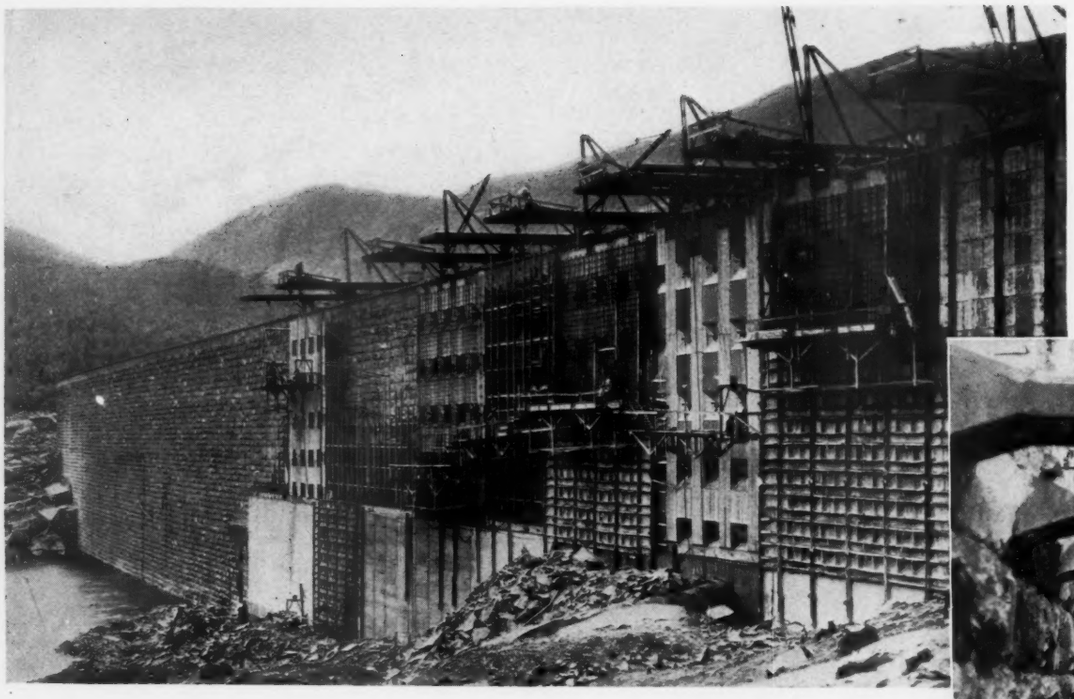
The conventional method of handling fry when they must be transported considerable distances is to place them in milk cans or similar containers, which are filled with water. As the fish require cool water and a plentiful supply of oxygen, means must be at hand to provide them with these essentials. The requirement of cool water can be met by changing the supply from time to time, or by refrigeration by ice or mechanical means. Replenishing the water automatically renews the oxygen, but where long trips are made, this involves frequent halts at some source of water supply or the alternative of carrying a rather large volume of renewal water in storage. Neither of these methods is desirable and to render them unnecessary, oxygen is introduced into the cans from time to time through the medium of compressed air.

The California Fish and Game Commission's two railway cars, which are in regular service out of the hatchery at Mt. Shasta, are each equipped with an air compressor for this service. One of these is a railroad-type, steam-driven unit which has a capacity of about 12 cfm. The other is an Ingersoll-Rand Type 15, air-cooled machine which has a piston displacement of 23 cfm. The air is compressed to 80-100 pounds pressure and stored in a receiver from which it is drawn as needed. By means of reducing valves, the pressure is lowered to 15 pounds or less for introduction into the cans containing the trout. *En route* to the containers, the air passes through a coil in the lower portion of a refrigerator where the temperature is maintained at 48° to 50°F. This obviates the placing of ice directly in the cans, as the compressed air both aërates and cools the water.

In addition to the compressor, each of these fish distribution cars contains complete mechanical facilities for the work involved and provisions for the crew of four men. There is an office for the superintendent, berths for all aboard, a kitchen, and a dining compartment. Besides the equipment mentioned, the engine room contains a boiler and two steel tanks of 500 gallons capacity each which carry a reserve supply of water for use in the fish cans in case of emergency.

Supplementing the railway cars are trucks, each equipped with a refrigerator and with an air tank which is charged with high-pressure air before each trip. The supply thus secured is sufficient for aërating the cans of fish until they reach their destination.

Where the fish must be taken into inaccessible mountain areas not penetrated by roads, resort is made to the time-honored pack train. Special rectangular-shaped cans that will ride well are swung over the backs of mules. Each container is 30 inches long, 30 inches high, and 12 inches wide. The lids are toward one side so that they can be opened while the cans are in place, thus facilitating inspection of the fish or changing of the water. During these journeys into the high country, the cans are kept covered with heavy cloth which is moistened from time to time. The natural evaporation of this water exerts a refrigerating effect which helps keep the water within the cans cool.



WALLED IN
Ringedal Dam (left) at low water during the construction of the diaphragm that is designed to protect the structure from further disintegration. The wall tapers in thickness and is held 6.5 feet away from the face of the dam by struts (below) which are heavier and spaced closer at the bottom than at the top.

Thin Concrete Diaphragm Makes Dam Watertight

Photos, Courtesy Engineering News-Record

THERE has been completed at Hardanger, Norway, an interesting job of reinforcing a concrete dam to check leakage and to safeguard the structure from further disintegration. Ringedal Dam serves as a storage basin for a hydro-electric plant, and was built between 1912 and 1918 when concrete was not prepared with the care that is practiced today to assure maximum strength and density. With passing years the masonry became increasingly pervious, until in 1929, when the work we are about to describe was undertaken, the average seepage amounted to 206 cubic feet of water per square yard of surface every 24 hours, including that along the base which was estimated at from 10 to 15 per cent of the total. The dam has a maximum height of 115 feet, a length of 1,710 feet, and the upstream face has an area of approximately 11,720 square yards. Exploratory borings for a distance of about 72 feet down from the crest revealed that the concrete, though porous, was generally in good condition except at or immediately above the construction joints and just behind the granite facing on the upstream side, where it had disintegrated.

Various attempts to check the leakage having failed, it was decided to repair the damage by a method developed and advocated by C. F. Groener, a consulting engineer of Oslo. This consisted of building parallel to the upstream face of the dam a thin, reinforced-concrete diaphragm that was calculated to keep the face dry—protect it against the destructive action of the water—and yet transmit the thrust of the water to the main structure.

The diaphragm tapers in thickness from about 8 inches at the top to 18.5 inches, and is held 6.5 feet away from the dam by rows of reinforced-concrete struts which are 12 and 17.75 inches in diameter in the upper and lower tiers, respectively. Horizontally, the struts are spaced on 7.25-foot centers, and in a vertical plane on from 10- to 6-foot centers—the rows being closer together throughout the lower part of the structure. The reinforcing is in spiral form, which made it possible to provide struts that are relatively slender and yet strong enough to withstand the pressure of the water against the diaphragm. They are anchored to the dam by 1- and 1.25-inch rods.

On account of the porous condition of the concrete, as determined both by the core drilling and by the holes for the anchor bolts, which were drilled to a point 4.5 feet back of the granite blocks, grout was forced into the dam at the base of each of the 1,700 struts. The material was applied to refusal at a pressure of 110 pounds per square inch and after the bolts were in place so as to tie them securely to the mass.

To allow for expansion and contraction independently of the dam, the diaphragm is divided into numerous sections by expansion joints—one running lengthwise and approximately 50 feet below the crest, and 38 extending from the top to the bottom. The distance between the latter varies from 34.5 to 63 feet, according to the interval between the vertical expansion joints in the dam proper. The joints have been made watertight by the use of either copper plates or a bitumastic material. The space between the diaphragm and the dam is covered over by a concrete slab, which is also provided with expansion joints corresponding to those in the structures it connects. Lights are set in the underside of the roofing to facilitate inspection of the intervening area. Any water accumulating there can be drained through the dam; and structural failures causing seepage can thus be immediately detected and repaired.

Because the bottom of Ringedal Lake is bared for only a short while in the spring of each year, the diaphragm had to be built in installments, and construction was limited to from 2 to 2½ months out of every twelve. It took three years to do the work, and in that interval the first two sections have been subjected more or less to the full pressure of the impounded water and also exposed for varying periods to a wide range of temperature changes. Neither one has shown any signs of weakness; and the entire structure, which has been in service now for the better part of a year, is said to be absolutely watertight and in every respect living up to the expectations of the designer.

CHINESE SAILING BOAT

A typical native junk shown on a stretch of the Yangtze River adjacent to the scene of the work described.

THE HAZARDS REMOVED

Looking up the south channel after the blast had demolished the two projecting rocks and provided an unimpeded waterway 12 feet deep at low-water stage. The surface of the Yangtze is now comparatively calm as contrasted with its mill-race current before the improvement was undertaken.

THE BLAST

This picture, secured from the firing point 400 yards away, shows the explosion of 16,200 pounds of gelignite, dynamite, and blasting gelatine which moved 10,000 cubic yards of rock and opened the south channel of the Yangtze River at K'unglingt'an to shipping at low-water stage.

A New Channel in the Upper Yangtze

H. R. DIXON

IT is a far cry from the Mississippi to the Yangtze-kiang. But even the great American river, forever famous the world over thanks to Tom Sawyer and Huckleberry Finn, cannot compare with the Yangtze in its importance to the country through which it flows, for the Yangtze is the principal, and, indeed, almost the sole means of communication for a population twice as large as that of the whole of North America. In the Province of Szechuen, alone, there are some 80,000,000 people, and the river also serves the inhabitants of six other wide provinces—those of Hunan, Honan, Hupeh, Kiangsi, Ahnwei, and Kiangsu.

Ocean-going liners of as much as 12,000 tons can, in summer, reach Hankow, 600 miles from the mouth of the Yangtze, and there is regular intercourse by steamer with Chungking, 1,300 miles upstream—smaller ships and launches continuing the chain of communication some 300 miles farther. Even then the traveler is only a little more than half way to the source of the river, away in the hinterland of Tibet, the cradle of the world.

Below Ichang the Yangtze passes through vast plains, and though difficulty is at all times experienced with shifting silt in the channels the bottom is soft almost throughout so that relatively few serious accidents endanger ships. But above that point, where the upper river begins, the change is sudden and complete, and sailors who travel its dangerous waters speak with pitying scorn of the "gravel scratchers" of the middle and lower reaches.

Steamship navigation on the upper Yangtze dates back to 1897. But the wreck of a German paddle steamer at K'unglingt'an, in the early years of this century, effectually discouraged further commercial efforts in that direction until 1908, when one vessel, the *Shutung*, started to run fairly regularly between Ichang and Chungking during the mid-level and high-level seasons from April to December. In 1914, other ships were put on that run; but it was not until 1922 that steamer traffic began in earnest and it was found possible to continue operating small ships throughout the low-water season. Since then all-year-round navigation has been maintained, different types of vessels being limited to particular levels.

The special features of this stretch of the mighty Yangtze are the phenomenal difference between the high and the low levels and the wildly beautiful country through which it flows. The famous gorges extend from Ichang upstream for about 100 miles, towering cliffs of limestone alternating with rapids. Some of the latter are difficult to navigate, while others are highly dangerous as well because of the swift currents and their rock-strewn channels, making a steamer's course extremely tortuous and demanding skill of the very highest degree from shipmasters and pilots. In the gorges, in summer, the water rises until it is as much as 200 feet above the winter level. So little is as yet known about the sources of the river that it is still a matter of argument whether this annual rise is caused primarily by rains over the vast watershed or by melting snows on the towering mountains.

To the navigator this is immaterial. In summer he has to face the seething torrent in the gorges and certain rapids that are rapids only at high level. In winter the channel narrows everywhere and the worst rapids appear. To give an idea of the difficulties encountered in the ordinary run of his calling, the Hsintan Rapids may be instanced. At low level there are three rapids at this point, the highest of which has a fall of 6 feet in a length of 50 yards. At such times all steamers have to assist their very powerful engines by passing wire ropes ashore from their winches. Even then a ship may take more

SINKING THE SHAFTS IN THE RIVER

To guard against inundation from sudden rises in the river and to provide adequate working platforms, reinforced-concrete cofferdams were built upon each of the two projecting rocks prior to sinking the shafts that were to make possible their demolition with high explosives. In the central picture, a workman is inspecting the western rock after the concrete cap had been poured. The same rock is shown at the top left just prior to the blast. The powder had been placed and the connecting bridges removed. The view at the right shows the eastern rock during shaft-sinking operations. Two of the "Jackhamers" used for drilling are hanging in racks on the side of the surmounting concrete cofferdam.

than an hour to negotiate this short stretch of water.

Some four miles below Hsintan lies the K'unglingt'an, the most notorious spot in the whole Yangtze. At low level the river at that point is divided by a great rock, called the *Tachu,* to the northeast of which lies a group of submerged rocks known collectively as the Pearls. The north channel, until this spring, was the only one open to shipping—the south channel being unnavigable on account of the presence at the western entrance of two large rocks which obstructed the swift current to such an extent that the whole channel was a turbulent mass of boiling water and swirling whirlpools.

Every year a number of vessels has been partly or totally wrecked on the Pearls, and about two years ago various shipping and commercial interests at Chungking combined to form the K'unglingt'an Improvement Commission—that is, to remove those hazards. It was decided to place the collection of the necessary funds and the direction of the technical work in the capable hands of the Chinese Maritime Customs, and R. G. Everest, the upper river inspector of the customs service, was instructed to take charge of the work. During that winter the river maintained an unusually high level, and there were ony ten days on which it was possible to do anything at all. By reason of the strong current and the large amount of silt in the water it was not feasible, as it had been hoped, to attack the submerged rocks by subaqueous drilling, and attention was therefore turned to the unknown but formidable south channel.

This was the situation in the autumn of 1932, when the writer became interested in the problem and was subsequently retained by the Maritime Customs as consulting engineer for the commission. From a description of the two large rocks in the south channel, as given by Mr. Everest, it seemed just possible that they might be dealt with by the method of mass-blasting. The rocks, themselves, could not be seen except at dead low water; and this meant that decisions had to be arrived at through a comparative geological study of the exposed rocks near by—Mr. Everest and his assistants in the meanwhile making a very thorough survey of the channel.

This had to be done from sampans, and the way in which the frail vessels swung and spun and swirled about in the current cannot be adequately comprehended by anyone not familiar with those waters. The results of the survey and the geological investigation were such that it was decided to make an attempt that winter to remove one of the rocks by mass-blasting. To that end an expedition set out from Ichang in December, and the Island of Tachu was selected as the best site for the camp because it was close by and offered a maximum of protection against sudden raids by bandits who infest the whole region. Tachu, itself, is 90 feet underwater in the summertime.

It was not until the end of January, 1933, that it was possible to gain a foothold on the rock; but in the interval a vast amount of work had been done in erecting a wharf and the explosive and detonator magazines and in making the necessary preparations for the sampan bridges which solved the difficult problem of access to the rocks. These bridges (for by that time the plan had been altered to include both rocks in the winter's program) consisted of "duck boards" laid on two steel-wire ropes and partly supported by sampans moored to a third. The current there ran at from seven to eight knots, and intervening submerged rocks caused such violent back

SCENES DURING THE OPERATIONS

Bridges partially supported upon sampans were constructed from Tachu Island to each of the projecting rocks that were to be removed (center), and the rocks themselves were linked by means of a 125-foot suspension bridge. These connections gave ready access to the points of work. Compressed air lines were run out on these bridges from the lighter shown in the foreground. This lighter carried a portable air compressor, drill-steel sharpener, oil furnace, and other essential equipment. In the picture at the top right it is shown lying off Ichang. The view at left was made while the native crew was moving the craft to a position of safety prior to the blast.

eddies that some of the sampans had to be prevented from racing upstream. After communication with both rocks had been established it was decided to throw a suspension bridge between the rocks, themselves, for taking soundings, something that it had not been possible to do from any kind of craft at that particular place. This bridge was 125 feet long and served its purpose admirably, being taken away soon after because of a sudden rise in the river.

After the first bridge was finished, construction was begun on the rock to which it led of a reinforced-concrete "ship" or cofferdam. This was designed to protect the mine shaft that was to be sunk there against any sudden rise in the river and to afford a cramped but sufficient working platform. The cofferdam was completed in four days in spite of considerable interruption by a sandstorm. Later on a similar one was built on the other rock. The larger one contained more than 100 tons of concrete.

During the waiting period a trial shaft had been sunk on the Island of Tachu, and this was of great assistance in training the Chinese salvage gang that had been sent up especially from Shanghai. Although none of the men had ever seen a mine shaft before, they rapidly became good miners under the leadership of Mr. Yagyu, the Japanese diver of the Chinese Maritime Customs. The amount of work they did in the time available was astonishing.

Prior to the establishment of the camp, while the river was still reasonably high, the special steel lighter—with its Ingersoll-Rand air compressor, drill sharpener, and oil furnace—had been moored alongside Tachu and air pipes run out along the bridge wires to the rocks. Thereafter, for eight weeks, work was continuous throughout the hours of daylight, and the shafts grew steadily deeper. Two of the "Jackhamers" were converted into rock rippers by the removal of the rotating pawls, and proved of the utmost value. The rock was an intensely hard granitic schist; and in one shaft a vein of quartz, 14 inches thick, dipped right across it at a steep angle. The schist, despite its hardness, fissured out dangerously when blasted, letting in increasingly large quantities of water as the shafts deepened. This was the reason for the use of the rippers, which reduced the shots by nearly 50 per cent, although without blasting to loosen the rock the tools would have been useless. Pumping was done by hand diaphragm pumps and by self-priming "Homelite" motor pumps, which were very satisfactory in the limited space available. It did, however, take time and patience to train the Chinese to maintain them at full efficiency.

The blacksmith was a Cantonese who spoke only one of the various southern dialects, and it just so happened that there was no one on the Island, either Chinese or foreign, who could talk to him. Nevertheless he did his work well; and with so much depending upon the plant and its steady performance, it is a great satisfaction to be able to record that neither the compressor nor the rest of the drilling equipment gave any trouble throughout the whole winter. When it is remembered that there was no possibility of obtaining additional spares or technical help save from Shanghai, 1,000 miles away by river, it will be appreciated that this reliability meant everything to us.

By March 12, we were ready to start laying the main charges. One of the shafts had to be lined with concrete from top to bottom to lessen the flow of water, while in the case of the other it was necessary to use mass concrete supports for the slender shaft walls because there was actually only 3 feet of rock between them and the river—the rock falling sheer on two sides

HOPE COTTAGE, BEFORE AND AFTER

Two views of the base of operations on Tachu Island—one as it appeared in winter garb and the other showing its dilapidated state after the blast had rained bowlders upon it. In summer, when the Yangtze rises as much as 200 feet, the tip of this rocky projection is 90 feet underwater. Owing to this circumstance, it was necessary to complete the work undertaken within a few months.

of the cofferdam to a depth of 40 feet. The concrete was placed underwater by a diver.

Charges totaling 16,200 pounds of gelignite, dynamite, and blasting gelatine were used and arranged for simultaneous detonation by duplicate electric circuits. After the main charges in their pitch-sealed gasoline cans had been put in the chambers at the bottoms of the shafts, reinforced concrete was laid over them; small demolition charges were placed in the cofferdams; and the openings were tamped with rock, sand, and concrete up to the tops of the dams. Last of all, especially prepared detonating charges were lowered down steel tubes that had been purposely left in the shafts; the bridges were removed; and the firing cables carried along overhead steel-wire ropes to the south bank and thence to the firing point 400 yards away. This was in a patch of sand, close to a large isolated rock, behind which had been built a strong shelter of double steel plates and sandbags strengthened with timber and empty cement barrels filled with sand.

The arrangements for the firing provided Mr. Everest with occupation for many days, for upon him fell the responsibility of seeing to it that the entire local population was moved to a safe distance. Such a task in western China is by no means a simple one. It took a great deal of tact and patience to bring the long-drawn-out negotiations to a successful close; and in this he was assisted by a troop of 100 sent there by the Government. These soldiers carried out their part of the work very well.

Although operations of the nature described entail many unavoidable risks, the care taken from start to finish, and the admirable arrangements made by Mr. Everest for the safety of shipping and of the inhabitants on the day of blasting, enable us to record—not without a measure of pride—that not one person came to harm throughout the whole winter as a result of the activities.

The mines were fired by Mr. Everest, on March 22, by switch and dry battery; and the excellent photograph of the explosion secured by Mr. Yagyu from the rock near the place of firing indicates how completely the area between the two rocks was involved. There was very little noise, as is usually the case with large shots in solid ground; and, because the rocks were merely protuberances on the river bed, no seismic disturbance was noticeable at the firing point. Pieces of rock were flung on top of the shelter and around it in all directions for a distance of 1,200 yards. The western end of Tachu was swept by an enormous wave; but there was no appreciable wave effect lower down the stream. More than 10,000 tons of rock was actually removed.

THE CHANNEL OPEN

View from the deck of first steamer to pass through the new fairway, March 28, 1933.

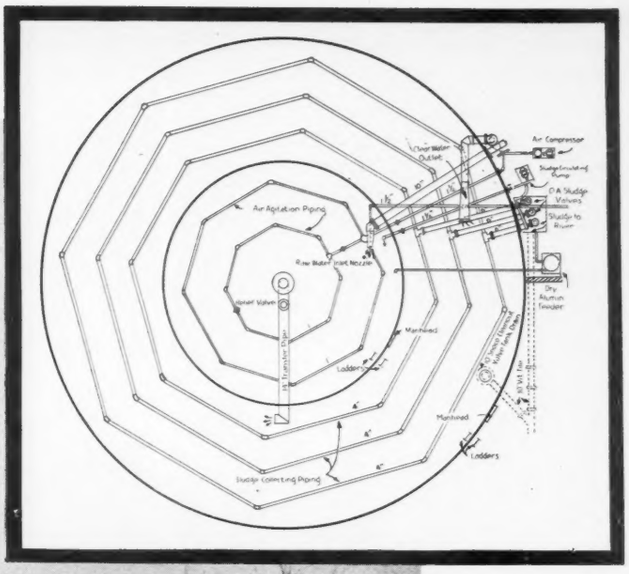
The immediate effect of the blast was a complete transformation of the south channel—its seething waters and whirling pools having disappeared almost entirely. Of the westernmost rock a small portion at the western extremity is still standing underwater, but the two main obstructing masses, together with the detached rocks lying between them, have been cleared away to a depth of 12 feet below the local low level. There is now a new channel between the island and the south bank with deep water from end to end—the pinnacle remaining being well outside of the fairway.

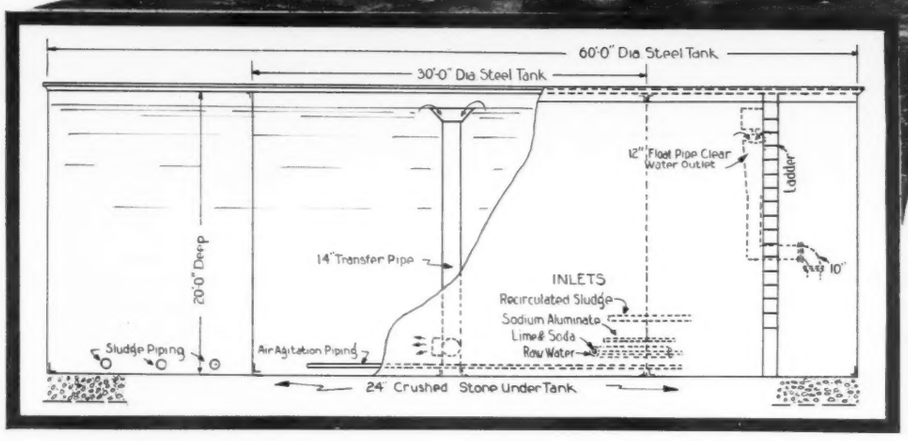
This is the first large-scale improvement project that has ever been carried out on the upper Yangtze, and great credit is due Mr. Everest and his staff for the thorough organization which characterized it and which alone made the engineering work possible. The tact and patience exercised by them in handling the heterogeneous Chinese labor, and the happy relations established with the local population, particularly constitute an achievement of which they may well be proud, and augurs well for further schemes of river improvement which undoubtedly will be carried out in the years to come to the great benefit of trade and commerce in western China.

Under Mr. Everest's command, the customs vessel *Hsia Kuang* made the first trips, three in number, through the new channel on March 28, and it is expected that shipping will make full use of that passageway now that winter is approaching and the water has begun to fall again.

Compressed Air in a Water-Softening Plant »»»

R. E. COUGHLAN*





LAYOUT OF TANKS

In this station at Clinton, Iowa, raw Mississippi River water is clarified and softened to render it suitable for use in locomotives. During the process the water is agitated with compressed air at a cost of only one cent for every 15,000 gallons treated. The two sketches give details of the tank equipment.

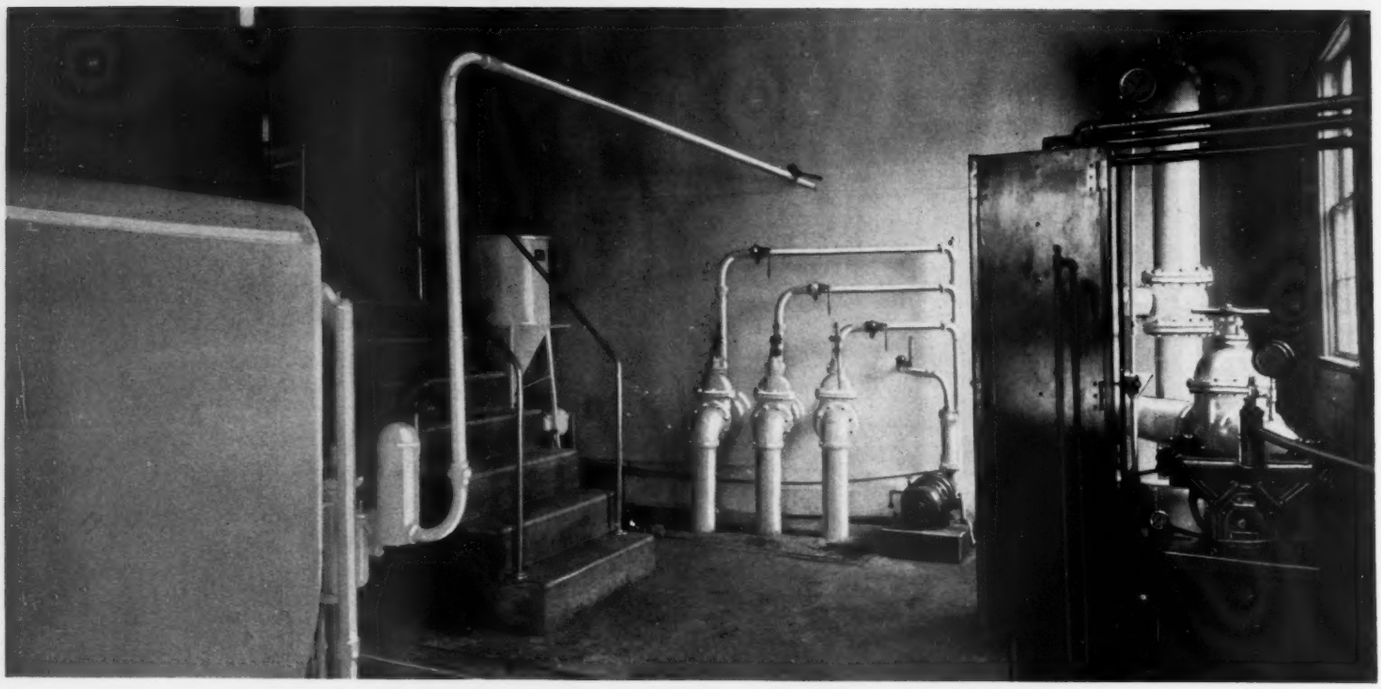
CLEAR, soft water is essential to the efficient operation of railroad locomotives. Solids carried in suspension or in solution quickly form deposits or incrustations which materially retard heat transfer and make it necessary to use more fuel to generate the required amount of steam. Continued use of such water soon renders the boiler incapable of attaining its rated output and within a short time the locomotive must be taken from service while the deposit of scale is removed and damage incidental to the use of unsuitable water repaired. Obviously, this is a costly and generally undesirable practice and, to obviate it, railroad systems go to considerable effort and expense to provide a suitable water supply at the many points where it is needed.

Sometimes the only natural water available is unsatisfactory and in such cases it must be treated before use. Removal of mud, silt, and other suspended solids can be accomplished by merely allowing the water to settle, or by filtering it, but dissolved salts which impart to water that quality which we term hardness call for the exercise of different means. The removal of the scale-forming salts is effected by introducing definite amounts of chemicals that react with these salts, forming insoluble compounds which settle and harmless soluble compounds which form no scale. Thorough diffusion of the chemicals is requisite to success and this calls for agitation of the water. Such agitation has conventionally been secured by mechanical means, but recently it has been found that compressed air is well suited for the task. Illustrative of its use in this connection is a new water-softening plant recently built at Clinton, Ia., by the Chicago & North Western Railway Company.

The water station at Clinton is one of the most important on the main line of the road between Chicago, Ill., and Omaha, Neb. Prior to the completion of the new plant, raw water from the Mississippi River was used, with no treatment other than partial settling. The water was pumped a distance of a mile from the intake point to two 80,000-gallon storage tanks. From these, it flowed through a 14-inch delivery line to three locomotive water cranes which supplied trains at the station. This distribution feature has been retained, the only difference being that the pumps now handle treated water instead of that taken directly from the river.

The river water at Clinton, as sampled over a period of twelve months, contains an average of 12 grains per gallon of incrusting solids and varying amounts of river mud and other suspended matter which at times exceed 500 grains per gallon. Analyses show that, as the result of the treatment now being accorded it, the incrusting solids are reduced to less than one grain per gallon and suspended

*Supervisor of Water Supply, Chicago & North Western Railway Co., Chicago, Ill.



A VIEW INSIDE THE STATION

In the background is a section of the wall of the outer tank, which contains within it a smaller mixing and reaction tank. In the center of the picture are three sludge removal pipes and at their right is the Motorpump which recirculates a portion of the sludge to assist the desired chemical processes in the inner tank. At the extreme right is the compressor which supplies compressed air for agitation.

matter to less than two grains per gallon. The oxygen content of the treated water is the same as of the untreated water. Agitation by compressed air has proved effective and a carefully kept record of costs based on actual meter readings reveals that the cost of the air is at the rate of only one cent for every 15,000 gallons of water treated. Compared with mechanical agitation, this showing is very favorable. Furthermore, additional savings are promised with respect to maintenance costs, as upkeep expense of the compressed-air system can reasonably be expected to be practically nothing.

In grains per gallon, the incrusting solids in the raw water range as follows: carbonate of lime, 3.92 to 4.36; carbonate of magnesia, 2.1 to 3.42; sulphate of magnesia, 1.03 to 2.87; oxides of iron and aluminum, .02 to 3.09; silica, .07 to .25; alkali chlorides, .48 to 1.16; alkali sulphates, .29 to 3.28. After considering the composition of the water and studying the possible processes of treating it, a decision was made to install a complete water-softening plant in preference to a filtration system.

The new plant is of the continuous type, with a daily capacity of 2,500,000 gallons, and is the first continuous-type softener to use compressed air for agitation. It was constructed by Peppard & Burrill of Minneapolis, Minn., under a contract awarded on a competitive bid basis. The T. W. Snow Construction Company collaborated with the contractors on the design and layout.

The treating facilities consist of two welded steel flat-bottomed, cylindrical tanks—a 400,000-gallon one 60 feet in diameter which has centrally erected within it a second 100,000-gallon tank. Both tanks are 20 feet high.

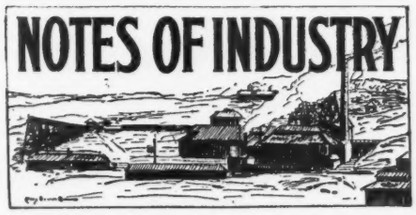
The inner tank is the mixing and reaction tank. Lime, soda ash, and sodium aluminate are introduced into it to precipitate and neutralize the incrusting solids, river silt, and mud. Thorough mixing is assured by agitation with compressed air which escapes through perforations in the bottom of two rings of 1-inch piping installed on the floor. Air at 40 pounds pressure is supplied by an Ingersoll-Rand Type 30 compressor which has a capacity of 40 cfm. The unit is a vertical, duplex, single-stage machine which is mounted on a common base with its driving motor, to which it is connected by v-belts.

The cycle of operation is as follows: Raw river water is pumped from an intake sump into the bottom of the inner tank at the rate of 120,000 gallons an hour. Lime and soda ash are introduced into the incoming water by means of a variable-rate International Filter Company chemical tank. To assist the desired chemical reaction, some of the sludge precipitated from previous operations is repumped into the tank at the rate of 30 gpm. For this service, there is installed a Cameron "Motorpump" which is fitted with an open-type impeller especially suited for the material it handles. As the name indicates, the pump and driving motor are built on a common shaft, thus producing a compact unit without a coupling and with a minimum of revolving parts and bearings.

Next the sodium aluminate is introduced into the tank by means of a National Type "P" dry feeder. Meanwhile, the mixture is being agitated violently by the compressed air flowing into it at the tank bottom. This serves to promote the formation of large floccules of precipitate which are inclined to settle rapidly. After one hour's time, the mixed water and chemicals are discharged through an overflow line into the outer tank. There the precipitate settles and is removed through perforated 4-inch radial piping at the bottom, terminating in quick-opening valves. The clear, softened water is taken out at the top of the tank by means of a Snoco clear-water take-off which is connected to the pumps which transfer it to the storage tanks.

The plant is run automatically through the functioning of a pressure-control switch which operates through a central-control panel board. When the height of the treated water in the outer tank has been reduced 12 inches by pumping, the contact of the control switch is automatically closed. This starts the air compressor discharging air into the inner tank and also into the bottom of the chemical tank to ease the starting of the chemical motor. After an interval of one minute, a timing device extends the circuit to the contactor which starts the raw water pump motors. Through auxiliary contacts, the energizing current is then carried, in turn, to the lime and soda ash pump motor, to the sodium aluminate feeder, and to the sludge pump. When the outer tank has become filled, the raw water pump, the sludge pump, and the air compressor, chemical pump and dry feeder are automatically stopped by the pressure control cutting in and opening the circuit.

The over-all time required to secure clear, soft water is about three hours. The pumps which transfer the treated water to the storage tanks also are arranged to start and stop automatically through the operation of a Sundh pressure switch.



Wood is being metallized in Germany by a method of impregnation not unlike that used in creosoting that material.

A method and machinery have been developed by which mineral aggregates are impregnated with asphalt, thus rendering them permanently waterproof.

The Turkish government, report has it, is planning to utilize its excess fig crop for the making of alcohol and to turn that liquid into a motor fuel by mixing it with gasoline.

The *Macon*, the U. S. Navy's newest dirigible, is equipped with a 500-watt searchlight for signaling that weighs but 11 pounds 4 ounces. It has a trigger-operated shutter that permits the sending of messages in code, and the light flashes emitted by it can be seen and interpreted eight miles away.

The Johnson Corporation of Three Rivers, Mich., has acquired the Gast line of air separators, aftercoolers, oil absorbers, etc., and R. O. Monroe has become manager of sales. This company manufactures Johnson rotary pressure joints for use in paper mills and other industries on steam, water, and other services, and is developing other steam and air devices.

To facilitate the maintenance and repair of its water and gas mains, electric lines, etc., the City of Moscow, in changing these public utilities from overhead to underground systems, is running them through a common conduit that is being made large enough to carry also a projected pneumatic tube for the transfer of packages and letters from the main post office to the various branches throughout the town.

Plans to improve the River Rhone have at last taken concrete form after years of discussion by the French authorities. From the Swiss border to Marseilles at the sea, a distance of 285 miles, the stream is to be made navigable and to be developed for irrigation and power purposes. It has been estimated that it will be possible within that stretch to produce a total of 5,000,000,000 kilowatt-hours annually.

Cellophane is being used to advantage by a midwestern manufacturer of motors for refrigerating units to prevent marring of their lacquer finish. Sheets of this material, placed between the motors when stacking them after painting, can be pulled free subsequently without leaving a fuzz or rough surface and will also protect them from the scratches and defacing imprints which they would otherwise give one another.

Beryllium copper is a new alloy that looks like pure gold and is said to have the following outstanding characteristics. With high tensile strength, high fatigue limit, and exceptional hardness it combines a relatively high electrical and thermal conductivity and a resistance to corrosion comparable with that of copper. Like the latter metal it can be easily machined, brazed, silver soldered, and soft soldered. It is the product of the American Brass Company, Waterbury, Conn., and is available in sheets, strips, rods, tubes, and wire.

Hydronalium, a new aluminum alloy produced in Germany, is reported to have all the advantages and none of the defects of present-day aluminum alloys. It is composed of aluminum, magnesium, and a very small percentage of manganese and differs from its forerunners in that it does not have to be worked in heat and is not affected by sea water or moisture generally. In certain conditions it may be welded, but so far structural hydronalium units have been bound together by riveting. The metal is manufactured in varying degrees of hardness and in plates having a thickness of 0.079 inch and upward.

Concurrent with the announcement that platinum coatings as thick as 0.02 inch can be deposited by electroplating comes the news from the Birmingham district of England that a process has been developed there for electroplating articles for table and ornamental use with platinum. This may mean that silver tableware will become out of fashion primarily because of platinum's untarnishable luster. The process has reached a commercially practicable scale, and is said to be simple as compared with other forms of plating. Uniform coatings of varying thicknesses are obtainable. The cost of the metal and the plant, though comparatively high, is offset we are informed, by the speed with which the work is done, the small overhead, and the superiority of the finish.

Nails with pitted or etched surfaces have increased frictional resistance to wood. This has been determined by the United States Forest Products Laboratory, which has also developed a chemical treatment to bring about this condition. The latter is obtained, the Government bureau reports, by subjecting the nails to the action of a 2 per cent solution of ferric chloride in water in the presence of mercuric chloride or salts of other metals, particularly of those falling below iron in the electrochemical series. On removal from the solution, they are allowed to dry in a warm atmosphere, after which they are exposed to a temperature of about 212° F. and a relative humidity of about 80 per cent. They are finally immersed in water to fix the adhering iron oxide. Depending upon the species of wood into which the nails were driven, they were found to have a holding power from 91 to 207 per cent higher than that of untreated nails.

A telescope of sufficient power to enable astronomers to photograph stars whose light is 1,000,000 times fainter than the dullest star the unaided eye can discern is to be erected in southwestern Texas. It will be housed in the McDonald Observatory, will be approximately 26 feet long, and will have a main mirror 80 inches in diameter and weighing 5,000 pounds. The new telescope will be owned by the University of Texas and operated by the University of Chicago. Because of the delicate nature of the manufacturing operations concerned, it will require two and one-half years to complete the assembly. Warner & Swasey Company of Cleveland, maker of other notable telescopes, has been awarded the contract for constructing and equipping the observatory, which will represent an expenditure of approximately $325,000.

ROCK BROUGHT DOWN BY ITS OWN WEIGHT IN ENGLISH QUARRY

ECONOMY in the use of explosives is practiced in a limestone quarry in northern England in which the rock is brought down mostly by its own weight. The rock is a magnesian limestone, and the face of the quarry is 60 to 100 feet high.

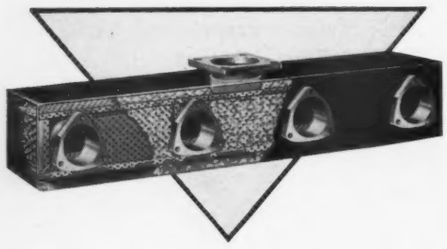
The method is to undermine the rock by driving a series of tunnels about 30 feet in from the face and connecting these at the back by a tunnel paralleling the face, thus leaving a number of pillars on which the main mass of the limestone rests. These pillars are drilled, loaded with gelignite, and shot simultaneously. The longer the rock hangs, the greater the quantity brought down. The largest fall so far recorded was a week in coming down. It totaled 40,000 tons, and required only 80 pounds of gelignite. Normally, an average of 30 pounds of gelignite is shot per 1,000 tons of stone.

SELF-LANDING BLIMP CARRIES PNEUMATIC BUMPER

A PNEUMATIC bumper is said to be a striking feature of the new pony dirigible, the *E-9*, recently turned over to the French naval air service. It is one of a fleet France is proposing to build, and is akin to the blimps in the United States Navy. Unlike the latter, however, it has a rigid keel running the full length of the airship, and in it are housed the crew's quarters, two 400-hp. propulsion engines, and the craft's guns. Just how the bumper is arranged and how it functions are not divulged; but it is said to enable the dirigible to land by herself—that is, unaided.

The *E-9* is 240 feet long, 65 feet from top to bottom, and has a maximum beam of 54 feet. She has a semi-rigid envelope, and her gas bags have a capacity of more than 353,000 cubic feet. When fully laden and traveling at 62 miles an hour, the ship has a radius of action of 1,550 miles; but stripped of her keel and armament and carrying extra fuel tanks instead she is capable of making 2,800 miles at a speed of 56 miles an hour. The *E-9* is the first dirigible that the French have built since the wreck of the *Dixmude*, the Zeppelin surrendered by Germany after the war.

NEW TYPE OF SILENCER FOR ENGINES, COMPRESSORS



THE Burgess Battery Company has developed a new silencing device for use on the intake or exhaust of internal combustion engines, compressors, or for any other application where the rush of air or gas causes objectionable noise. The silencer does not depend upon baffles or deflectors but utilizes, instead, a porous material to absorb the sound. Perforations permit the air or gas to flow without appreciable obstruction, thereby keeping back pressure to a minimum. It is claimed that this type of construction has several advantages over silencers of conventional design. The new product is being made in the company's Madison, Wis., factory.

TRENCHING MACHINES EQUIPPED TO PREVENT PIPE DAMAGE

WE HAVE it on the authority of the *Excavating Engineer* that a warning and stop mechanism has been devised for multiple-bucket trenching or ditching machines that successfully prevents them from seriously damaging underground water mains, gas pipes, telephone conduits, etc. The device is the invention of Roy D. Pavlik, of Kenilworth, Ill., and consists of a control circuit drawing current from a storage battery. One end of the circuit is grounded in the metalwork of the machine and the other is connected with, let us say, a nearby water plug or some convenient part of the particular system that may be encountered during trenching.

Normally, the circuit is open; but when metal comes in contact with metal, one of the buckets with the pipe, the circuit is completed, thus causing a series of relays or electromagnetically controlled mechanisms to close and to remain closed until released by the shovel operator. The equipment has been tried out under service conditions, and is said to act so quickly that the obstructing pipe sustains nothing more than a scratch.

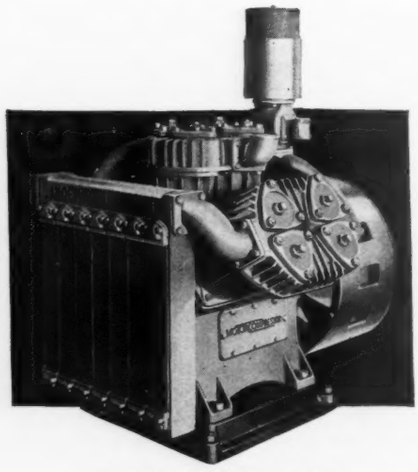
TESTING MACHINES FOR LEATHER BELTS

THE FACT that a leather belt may last anywhere from 3 to 30 years, depending upon its size and the severity of the work it performs, makes it difficult for the manufacturer of belting to determine in the laboratory the probable life of his product. Yet it is important that he should know how his belts wear, how much they are liable to stretch, whether they will be as efficient after several years of service as when new, etc., etc.

To enable them to establish all these facts within a reasonable length of time, the research staff of E. F. Houghton & Company, well-known makers of leather belting, has developed a so called accelerated endurance testing machine. On this machine two belts are run in opposition to each other and over pulleys of slightly different diameters so that each belt is forced to slip approximately 5 per cent. In addition, the belts are operated under a tension of 100 to 125 pounds per inch of width, which is about double the normal tension for a single-ply belt. This combination of forced slip and high tension makes it possible, so it is said, to give a belt in one day of 24 hours the equivalent of two months of regular wear. These figures were arrived at by taking the life span of hundreds of belts as indicated by the machine and the probable service life of the same belts and averaging them.

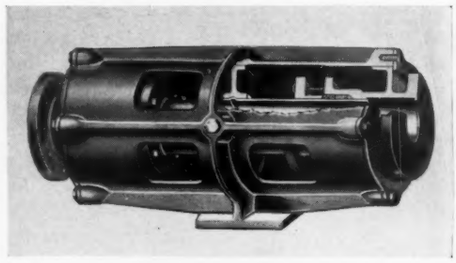
BELT TESTING MACHINE

When E. F. Houghton & Company recently produced a new kind of nonskid leather belt with a ribbed surface, one of the questions the research staff had to answer was whether the ribbed tread would wear down smooth in operation. To determine this, several small belts of that type were tested for a period of 30 days, at the end of which time they were in the condition in which they would have been had they had five years of use. Upon the termination of this endurance run the ribbing, as the insert in the accompanying illustration shows, was still in good shape.



THE MOTORCOMPRESSOR

NEW EXPANSION JOINTS FOR PIPE LINES



DIRECT Separator Company, Inc., Syracuse, N. Y., announces improved expansion joints for compressed air or steam lines up to 24 inches in diameter. They are externally guided and are made of single-slip type for pressures up to 125 pounds and of double-slip type for pressures up to 250 pounds. These joints are distinctive in that the sliding member is composed of the stuffing box and guides, the external guide being inclosed in a cylinder which extends the full length of the joint, and the internal guide being inside the stuffing box and adjacent pipe section. The external part is a single casting which is strong and heavily ribbed. It is carefully machined and all sliding parts maintain their alignment. The joints are ready to install as shipped. Ample openings are provided for repacking. Machined bases can be supplied if desired. Joints of all sizes can be furnished standard, extra heavy, or of cast steel. The joint illustrated is of the double-slip type.

NEW AIR-COOLED COMPRESSOR

A NEW type of air compressor that requires no cooling water and is, accordingly, particularly well adapted for certain applications where water is scarce, costly, or objectionable, has been developed by Ingersoll-Rand Company, 11 Broadway, New York City.

The new machine is called the Motorcompressor and, as the name implies, has a built-in motor. The motor rotor is carried on the compressor shaft and the motor frame is bolted directly to the compressor crankcase. This construction eliminates a coupling, as well as motor bearings. A rigid sub-base underneath the entire unit makes for a compact machine.

The Motorcompressor is a 2-cylinder, 2-stage machine. Cylinders and intercooler are air cooled. Units are built in sizes from 20 to 50 hp., with piston displacements from 113 to 310 cubic feet per minute and for discharge pressures up to 125 pounds gauge. The overall efficiency is equal to or better than that of conventional water-cooled compressors of corresponding capacities.

The Motorcompressor is designed to meet the need for an efficient, moderate-size, motor-driven, air-cooled compressor. It can be used for general service or as a standby unit wherever air is required, but is especially suited for locations where water cooling is objectionable or out of the question because of the freezing hazard or for other reasons.

AUTO-FEED FOR DRIFTER DRILLS ANNOUNCED BY I-R

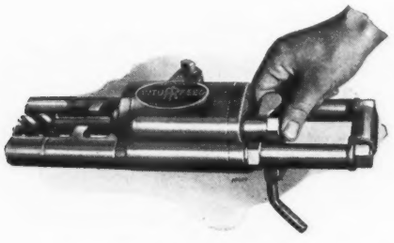
AN automatic feeding device for drifter drills which makes hand cranking unnecessary has been introduced by Ingersoll-Rand Company, 11 Broadway, New York City. In addition to eliminating the need for constant attendance of the drill and thereby freeing the operator for other duties, the Auto-feed, as it is known, increases the production per drill.

The Auto-feed makes use of no power medium and is completely automatic. It derives its action from the natural tendency of a running drill to creep when the feed screw is allowed to turn in only one direction. The mechanism, which is attached at the end of the feed screw, consists of two ratchet heads, around each of which is a ratchet ring having both internal and external teeth. Pawls on the two ratchet heads are arranged so that, depending upon the direction of rotation, the feed screw is locked to one or the other of the rings. This serves to feed the drill either forward or backward, according to which ring is locked. The direction of feed can be reversed by throwing a conveniently located lever. A brake permits retarding the rate of feed or stopping it entirely. When the drill is not running, it can be freely moved in the shell.

When starting a hole, the operator feeds the drill up to the rock face slowly by opening the air throttle partially. When the bit reaches the rock, he opens the throttle further. In even ground, after the hole is collared, he need pay no more attention to the drill until a change of steel is necessary; in broken or fitchery ground, by proper manipulation of the Auto-feed, he is able to put in holes easily where it would be extremely difficult or sometimes impossible to do so with the hand crank. By reversing the direction of rotation, the drill will automatically run back. This reduces the time required to change steels.

Other advantages claimed for the Auto-feed are: greater over-all footage per man shift; better control of the drill in fitchery ground; it pulls tightly held steels that are difficult or impossible to extract by hand cranking; it will operate in close quarters and permits placing edge holes where blasting will prove most effective—something that is often impossible with hand cranking because of the scant room available.

Drills equipped with Auto-feed are but slightly longer and heavier than hand-cranked models. There is no increase in air consumption.

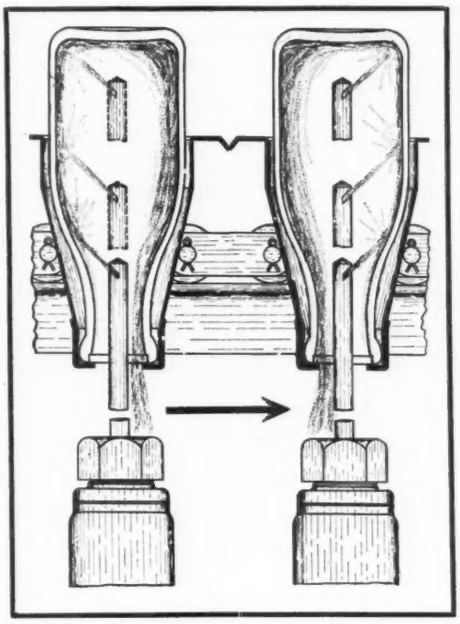


AUTO-FEED ATTACHMENT

The hand is in position to throw the lever that reverses the direction of feed.

WASHING INSIDES OF BOTTLES WITH COMPRESSED AIR

HAVE you ever wondered how interiors of milk bottles or beverage bottles which are reused many times are cleansed prior to their refilling? One of the most modern machines for performing this service utilizes compressed air to drive streams of water at high speed against the inside surfaces of the bottle, thus effecting a scouring action which is claimed to be superior to that which can be obtained by other means.



SECTION OF WASHER

The illustration shows how this method is applied to the scouring of the insides of milk bottles. As each bottle travels, mouth downward, on a carriage it reaches a position where a spindle, carrying what is known as an air-and-water head, rises within it and releases as it does so a high-velocity stream of water which is propelled by compressed air. This stream produces a fan-shaped spray which is carried around to all surfaces of the bottle, but which directs its greatest impact against only one side. To complete the scouring a second spindle, from which the water is sprayed in the opposite direction to that of the first spindle, is introduced into the bottle.

One outstanding advantage claimed for this type of washer is its capability of reaching every portion of the interior, which makes it suitable for cleansing irregularly shaped bottles with the same effectiveness as those of simple lines. Its freedom from mechanical limitations and the fact that it scours the capseats of milk bottles as thoroughly as other portions are given as other features of this equipment. These air-brush bottle washers, as they are termed, are manufactured by the Michael Yundt Company of Waukesha, Wis., and are installed in many of the leading milk dispensaries of the country. A variation of the machine has recently been put on the market to adapt the process to the washing of interiors of beverage bottles.

ROCK GRAB FOR HANDLING LARGE STONES IS ANNOUNCED

BUCYRUS-ERIE Company, South Milwaukee, Wis., has placed on the market a new piece of equipment called the rock grab which is designed to pick up and move large rocks of either irregular or regular shapes. The device works on the same principle as a clamshell bucket. It has two opposing jaws which close against the sides of the rock and which exert a constantly greater pressure as the lifting pull is increased. The rock grab is suspended from the boom of a crane and is worked through a multiple-part rope hitch. By using rubber pads, cut or polished stones can be handled without marring. The rock grab is furnished in 5-, 10-, and 20-ton sizes

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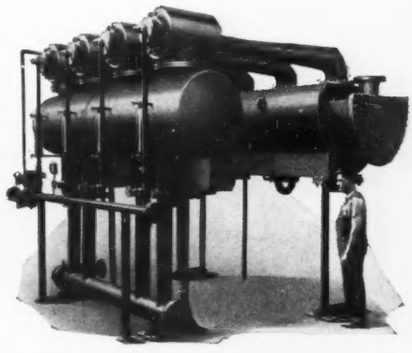
AN ENGINEERING DISCUSSION OF STEAM-JET REFRIGERATION

INGERSOLL-RAND COMPANY, 11 Broadway, New York City, has issued an illustrated bulletin, "Steam Jet Vapor Refrigeration Units." Copies are obtainable upon request from any branch office of the company.

The publication takes the form of a general engineering discussion of the subject of producing refrigeration by the evaporation of water. It was designed to be of practical aid to engineers concerned with providing cooling effect for either air conditioning or industrial process work, and also of general interest to architects and executives.

The booklet discusses the theory and practice of water-vapor refrigeration, the importance of correct steam-jet design, the operating characteristics of steam-jet boosters, and the steam and water requirements of this type of apparatus. The general arrangement and construction of Ingersoll-Rand units is described, including the distinctive method of controlling the capacity of multiple-jet machines which is obtained by dividing the evaporator into individual compartments for each jet. This provides flexibility and operating economy, as it permits the shutting down of one or more jets when they are not needed.

In addition to reproductions of shop and installation photographs, the bulletin contains several diagrams which explain the operation of steam-jet refrigeration equipment.



STEAM JET REFRIGERATOR

This 100-ton unit was built for air-conditioning service.